'ATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	19 March 1993	Final Technical Report (CDRL A007)

4. TITLE AND SUBTITLE
CORPS Surface-to-Air Missile (SAM) System Manpower, Personnel and Training Analysis

5. FUNDING NUMBERS
C #DABT60-90-D-0010

6. AUTHOR(S)
Lafond, Ronald H.
Crump, Steve

7. PERFORMING ORGANIZATION NAMES(S) AND ADDRESS(ES)
AEPCO, Inc.
15800 Crabbs Branch Way, Suite #300
Rockville, MD 20855-2622

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAMES(S) AND ADDRESS(ES)
U.S. Army Training & Doctrine Command (TRADOC)
ATTN: ATCA
Fort Eustis, VA 23604-5538

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Distribution Statement A: Approved for Public Release; Distribution is Unlimited

13. ABSTRACT *(Maximum 200 words)*

The object of this delivery order was for AEPCO to perform a manpower and personnel integration (MANPRINT) analysis on the Corps SAM System in order to address new MPT requirements. This included the following: (1) determining manpower requirements for Corps SAM system alternatives identified in the COEA study plan; (2) Verifying Additional Skill Identifiers (ASIs) within the family of Ground Based Air Defense Systems; (3) determining impacts of any new combined operator/maintainer MOS; (4) performing a training resource requirements analysis (TRRA) with the goal of evaluating the potential for a "common core" training track system supporting family of ground based air defense system; and, (5) feeding the results of the MPT analysis into the Corps SAM COEA for Milestone (MS) I decision review. In addition, AEPCO identified several safety, Human Factors Engineering (HFE), and health hazards impacting MPT resources, thereby providing a complete "MANPRINT look" at the Corps SAM.

14. SUBJECT TERMS	15. NUMBER OF PAGES
Cost and Operational Effectiveness Analysis (COEA) Manpower, Personnel and Training (MPT) Manpower & Personnel Integration (MANPRINT)	83
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	

CONTRACT NO. DABT60-90-D-0010
DELIVERY ORDER 0006

FINAL TECHNICAL REPORT

(CDRL A007)

CORPS SURFACE-TO-AIR MISSILE (SAM) SYSTEM MANPOWER, PERSONNEL AND TRAINING ANALYSES

19 March 1993

Submitted to:

U.S. Army Training and Doctrine Command (TRADOC)
ATTN: ATCA
Fort Eustis, Virginia 23604-5538

Prepared by:

AEPCO, Inc.
15800 Crabbs Branch Way, Suite 300
Rockville, Maryland 20855-2622

UNCLASSIFIED

F I N A L
T E C H N I C A L
R E P O R T

CORPS SURFACE-TO-AIR MISSILE (SAM) SYSTEM MANPOWER, PERSONNEL, AND TRAINING ANALYSES

TABLE OF CONTENTS

TABLE OF CONTENTS

List of Figures

List of Tables

List of Tables

EXECUTIVE SUMMARY

1. The purpose of this project was to perform a manpower, personnel, and training (MPT) analysis of the CORPS Surface-to-Air-Missile (SAM) system in conjunction with a Cost and Operational Effectiveness Analyses (COEA). The COEA Study Plan, as the TRADOC MPT integrating document, is designed to consider MPT requirements representing several viable alternatives. The statement of work (SOW) required the contractor to perform the following tasks: (1) determine MPT Force Structure requirements for inclusion in the Operational Requirements Document (ORD) and CORPS SAM COEA in support of the Milestone I Decision Review; (2) determine training resource requirements for each major COEA alternative including the impact of embedded and stand-alone training devices; and (3) determine how Human Factors Engineering (HFE), System Safety, and Health Hazard issues affect CORPS SAM MPT resources. Analysis of MPT requirements at depot facilities was beyond the scope of this delivery order.

2. CORPS SAM MANPRINT issues and concerns are discussed in Section 3. Several CORPS SAM HFE, System Safety, and Health Hazard issues were identified and were based primarily on heavy reliance on the two level maintenance concept (unit and depot).

3. The Manpower and Personnel Requirements Analysis was performed for the Base Case (HAWK III) and the four major alternatives (USMC HAWK, PAC-3, PAC-3 "Light", and CORPS SAM) in conjunction with the COEA Study Plan. The CORPS SAM manpower requirements per battalion (507) are slightly higher than the current HAWK III manpower requirements (497). This can be attributed to the additional ADA battery and <u>not</u> to the workload demands of the new system. Manpower requirements for the PAC-3 and PAC-3 "Light" alternatives equated to 544 positions per battalion since operator (MOS 16T) and maintainer (MOS 24T) manpower requirements are higher than those of the Base Case and require significant increases in support equipment operator and maintainer MOS slots, particularly in wheel vehicle maintenance and fuel transport operators. Manpower requirements for the USMC HAWK amounted to 551 per battalion because operator (MOS

14D) and maintainer (MOS 23R) manpower requirements are higher than those of the Base Case and a DS Maintenance requirement which can be attributed to the additional battery. The manpower impact on the Intermediate Direct Support Maintenance Company was also assessed. Personnel aspects of the analysis included use of the 14D Target Audience Description for the enhanced CORPS SAM Operator 14X MOS and application of Standard of Grade Authorizations to the respective manpower requirements.

4. A Training Resource Requirements Analysis (TRRA) was performed for the Base Case and the four major alternatives in conjunction with the COEA Study Plan with the respective training results provided in Section 5. Training course data includes annual student inputs, instructor manpower requirements, and course costs. A course module report consisting of quasi-Programs of Instruction (POIs) for two new CORPS SAM operator courses were provided to interested parties under separate cover. CORPS SAM training requirements decreased significantly when compared to the Base Case. For example, the total Annual Training Man-Days decreased 36.5% from 102,812 to 65,236; the total Annual Instructor Requirements decreased 62.6% from 115 to 43; and the total Annual Course Costs decreased 66.8% from $28,982,000 to $9,610,000. These decreases were caused by the elimination of the following MOSs: (1) 23R unit maintenance; (2) 27J and 27K DS/GS maintenance; (3) 25L AN/TSQ-73 maintenance; and (4) 35Y Integrated Family of Test Equipment. The elimination of these MOSs reduced the training base by nine courses.

5. This CORPS SAM MPT analysis will assist the Milestone I Decision Review process by meeting the US Army and OSD Human System Integration (HSI) requirements in the following areas: (1) support COEA alternative and Baseline Cost Estimate analyses during the Concept Exploration and Definition phase; (2) create a baseline for the Demonstration/Validation phase; (3) develop key MPT resource information for TMD-level integration; (4) provide a rapid response analytic capability for program changes and system tradeoffs; (5) identify MPT issues/risks for timely resolution; and (6) support the US Army through a cost-effective use of available program resources and information.

SECTION 1.0

OVERVIEW

1.1 BACKGROUND. The CORPS SAM program was initiated in 1987 when it was initially identified as the Medium Surface-to-Air Missile (MSAM) project. A system need was determined from data generated during a study of threat deficiencies that existed in the fielded low-to-medium air defense system. The present CORPS SAM program was initiated in early 1990. Authority to enter the Concept Exploration and Definition (CE&D) phase was directed by an Army Acquisition Executive Memorandum, dated 6 August 1990. The CORPS SAM program was assigned to Project Management Office (PMO) authority in September 1990. CORPS SAM is an Army Air Defense Artillery (ADA) weapon which will replace HAWK III. The CORPS SAM system will be fielded around the year 2005 time-frame. The CORPS SAM system is envisioned to be the center of the Army's Corps Area Air Defense. The Army Battlefield Development Plan identifies the need for a Corps air defense capability which was attributed to inherent limitations in the current HAWK air defense system. An analysis of the mission area indicated that the Corps air defense need cannot be satisfied by a non-materiel solution. The Joint Requirements Oversight Council (JROC) approved the validated Mission Need Statement (MNS) on 3 August 1990 requiring an air defense capability to meet the evolving air threat.

1.1.1 Performance Requirements/Goals. The CORPS SAM system must have the capability to kill airbreathing threats such as fixed-wing (FW), rotary-wing (RW), unmanned aerial vehicles (UAVs), cruise missiles, and tactical ballistic missiles (TBMs) within its engagement envelope in the presence of Electronic Countermeasures (ECM). For TBM engagements, the CORPS SAM system will combine sufficient high intercept altitude and warhead lethality to minimize the effects of chemical, high explosive, and biological payloads at ground level. CORPS SAM must provide other desirable characteristics that HAWK presently cannot provide. The system will be linked with the Forward Area Air Defense System (FAADS) in the forward area to provide air defense to the Maneuver Force. It must be capable of protecting assets located in the Echelons Above Corps (EAC) area in

conjunction with other EAC systems such as the Theater High Altitude Area Defense (THAAD) and PATRIOT systems. The CORPS SAM system, therefore, must be interoperable with existing and planned U.S., Joint, and Allied Air Defense weapons and BMC^3I systems such as THAAD, PATRIOT, and FAADS (see **Figure 1-1**). The system will operate in all battlefield environments, including all weather, day/night, man-made and natural obscurant and countermeasure environments. The system must be strategically and tactically deployable, and tactically mobile for deployment into and within any theater of operation. The CORPS SAM system must have long-term storage capability and be capable of being rapidly mobilized and deployed in modular configurations for use in conflicts ranging from immature through mature theaters of operation. The system must be manpower efficient, anticipating force structure levels of less than 500 slots per battalion. All proposed weapon systems must meet certain criteria; i.e., transportable via C-130 aircraft, subsystems transportable via CH-47D helicopter, sufficiently flexible deployability to engage front line targets as well as provide rear echelon air defense support.

1.2 SYSTEM DESCRIPTION. The CORPS SAM system is a major new system start, consisting of netted, distributed, and replicated components capable of providing Corps ADA coverage collectively. These components are required to execute ADA missions supporting Airland Operations. The CORPS SAM system is expected to be employed as an integrated battalion distributed over an area of influence as large as 100 kilometers (KM) by 200 KM and may fight as part of a complete defense Task Force (e.g., PATRIOT/ HAWK/Avenger/future ADA systems) fully interoperable with both High-to-Medium Altitude Defense (HIMAD) and FAADS. CORPS SAM is a medium range, mobile ADA weapon intended to protect ground forces from attack by aircraft, helicopters, and TBMs. The system will consist of multiple subsystem elements and be modular in design. The modularity design permits reconfiguration of the system considering mission, enemy, troops, terrain, and time (METT-T) for rapid deployment with the requirement for less aircraft and to meet intra-theater airlift transportability requirements. The CORPS SAM's subsystem elements will consist of: weapon system kill vehicle, multi-function radar, BM/C^3, tactical operations center (TOC), and associated support equipment.

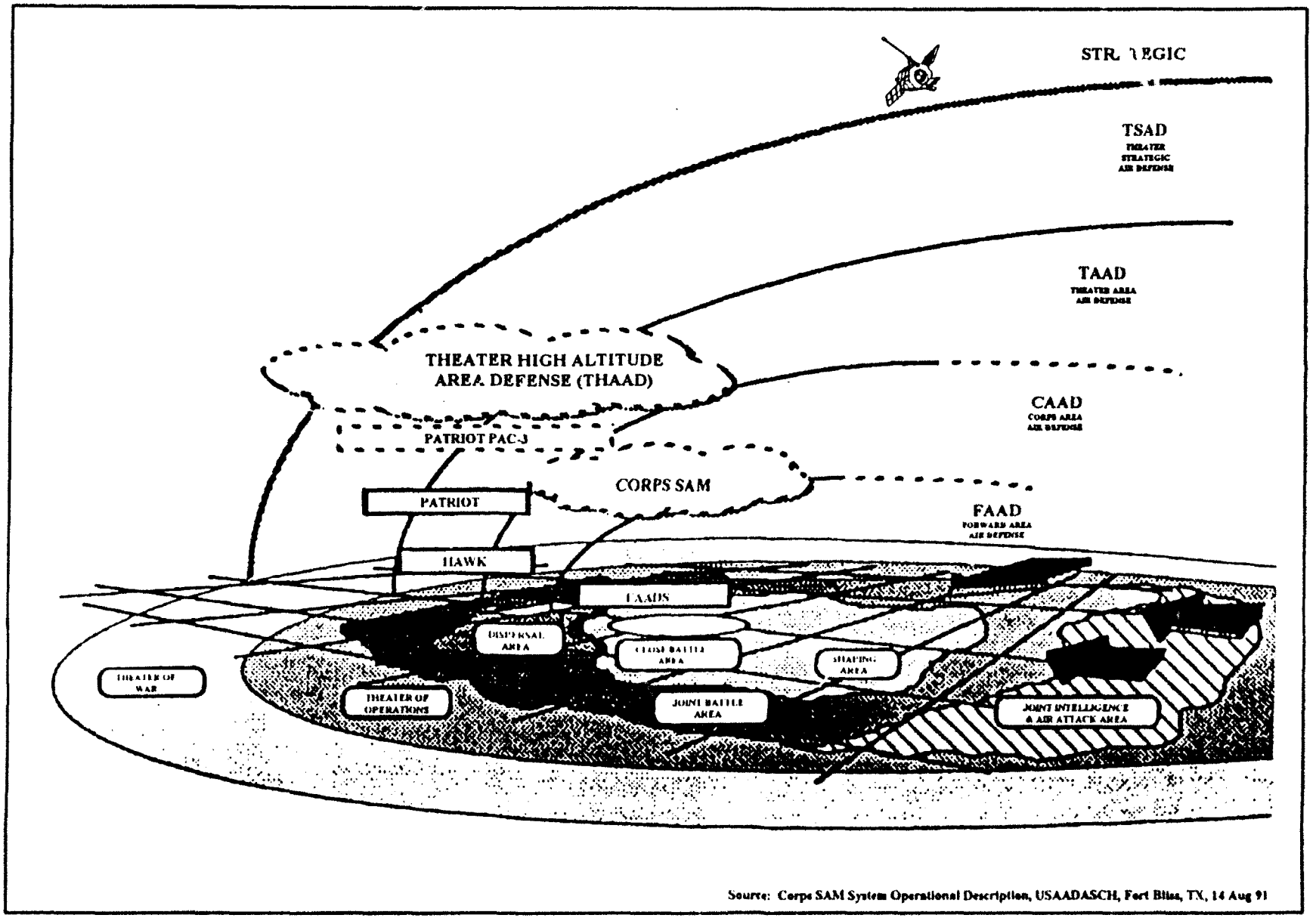


Figure 1-1 Emerging Solutions

1.2.1 **System Software.** The software requirements will vary with the type of system configuration that is finally selected but all systems must be supported by Automatic Test Equipment (ATE) and Built in Test/Built in Test Equipment (BIT/BITE) to provide logistical support and maintenance.

1.2.2 **Training Devices.** A future training device feasibility study included in the CE&D phase Logistics Support Analysis (LSA) process will determine the requirements for training devices and simulators. The CORPS SAM System Training Plan (STRAP) identifies the following training devices designed to support both institutional and unit training.

(1) Air Defense Tactical Operations Center Trainer;

(2) Ground Based Sensor Trainer;

(3) Missile Round Trainer;

(4) Firing Platform Trainer;

(5) Explosive Ordnance Disposal Trainer;

(6) Tactics/Fault Generation System;

(7) Air Defense Combined Arms Tactical Trainer: and

(8) Embedded Trainers for ADTOC and Ground Based Sensor operator/maintainer sustainment training.

1.3 UTILITY OF FRONT-END ANALYSES. Several recent examples of successful MANPRINT efforts early in the acquisition process include the following: the Line-of-Sight-Forward-Heavy (LOS-F-H), the Light Helicopter Experimental (LHX), and the T-800 helicopter engine (source: MANPRINT 2000: Program Assessment and Enhancement produced by the Under Secretary of the Army for Operations Research). These MANPRINT success stories have proven the value of conducting early "front-end" analyses in order to ensure that MPT considerations are effectively addressed in the acquisition of Army materiel systems. The recent promulgation of Department of Defense Instruction (DoDI) 5000.2 entitled "Defense Acquisition Management Policies and Procedures" has mandated the early assessment of human considerations and its costs under the title of Human Systems

Integration (HSI). Inherent human factors problems associated with high technology design, the declining size of the recruitable manpower pool, high manpower and training costs, and competition for skills are constraints forcing the U.S. Army to adopt a more disciplined approach to people planning in the materiel acquisition process. "Skill creep" (technology driven trend toward increasing skill requirements with each new generation of equipment) is also pressuring Army planners to design equipment that can be operated and maintained based on the aptitude level of soldiers coming into the Army from the available human resource pool. The most effective way to handle "people-equipment mismatch" problems is to use front-end manpower and personnel integration (MANPRINT) analyses as the basis for projecting and controlling the MPT requirements of new materiel systems. In the case of the CORPS SAM system, it is anticipated that the "front-end" logistics and MPT analyses performed by several support contractors, including this team's analysis, should help minimize the human systems integration problems that may be encountered by the CORPS SAM system during the CE&D phase of the materiel acquisition process.

SECTION 2.0

TECHNICAL APPROACH

2.1 STATEMENT OF WORK (SOW). TRADOC Analysis Command (TRAC) at Fort Benjamin Harrison, Indiana, directed that our work be focused on the following:

(1) Determine MPT Force Structure requirements for inclusion in the Operational Requirements Document (ORD) and CORPS SAM COEA in support of the Milestone I Decision Review.

(2) Identify ways to reduce high driver MPT impacts given CORPS SAM resource constraints.

(3) Determine training resource requirements for each major COEA alternative as a result of embedded and stand-alone training devices.

(4) Determine how Human Factors Engineering (HFE), System Safety, and Health Hazard issues will affect CORPS SAM MPT resources.

We recognize that analysis of MPT requirements at depot/ overhaul facilities is important. However, this analysis was beyond the scope of this delivery order.

2.2 TECHNICAL APPROACH. We employed a "tailored" analytical approach, using only those Hardware versus Manpower (HARDMAN) steps that were necessary to determine accurate MPT requirements in the interest of cost effectiveness. The technical approach used to determine CORPS SAM MPT requirements consisted of the following steps (see **Figure 2-1**):

(1) Review ADA MPT data and documentation;

(2) Review CORPS SAM and predecessor documentation;

(3) Determine Milestone I MPT analysis support requirements;

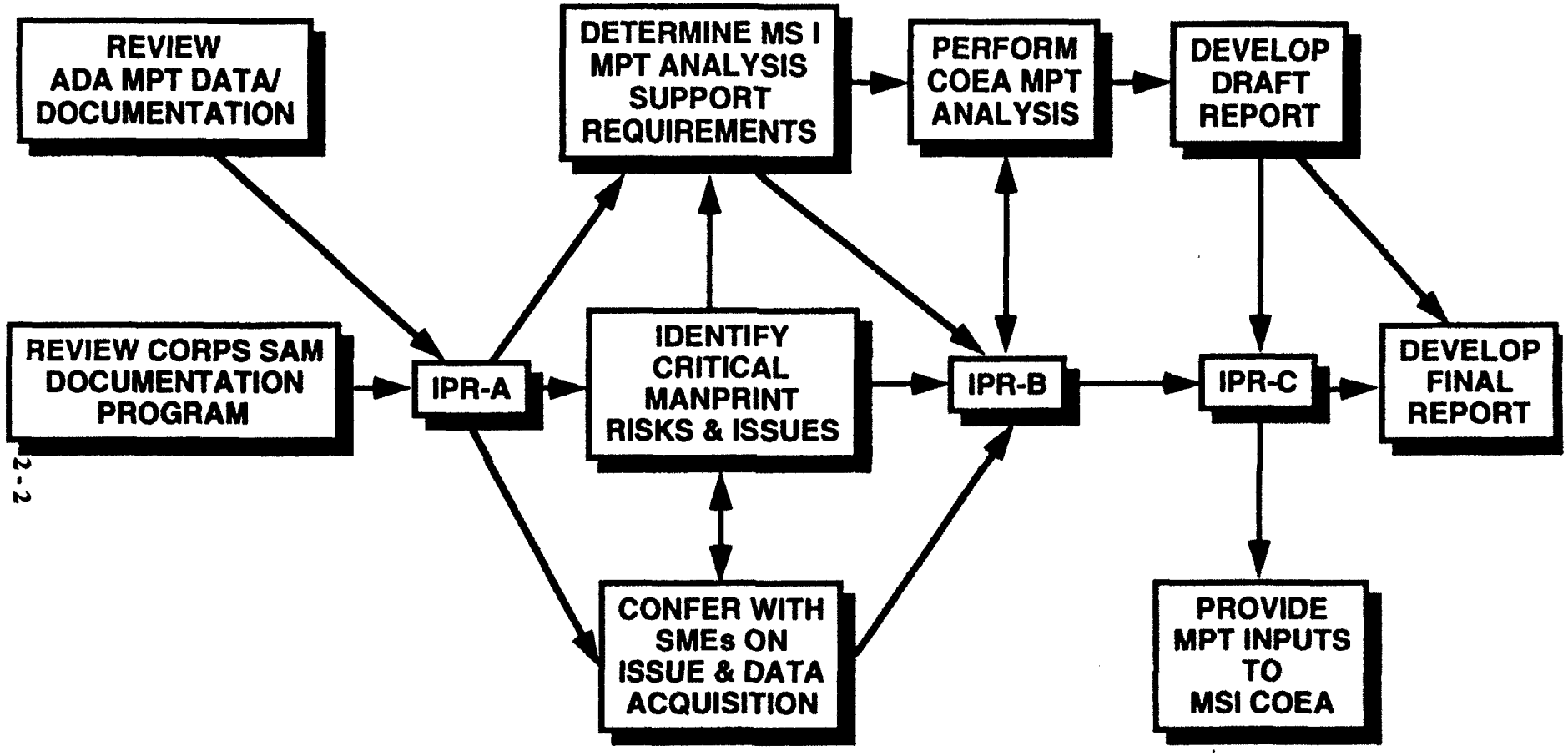


FIGURE 2-1

CORPS SAM MS I MPT ANALYSIS
TECHNICAL APPROACH

(4) Identify critical MANPRINT risks and issues;

(5) Interview selected SMEs and targeted users/materiel developers (MATDEVs);

(6) Determine MPT requirements for each major COEA alternative; and

(7) Provide recommendations to TRAC-Fort Benjamin Harrison (FBHN), Indiana, and White Sands Missile Range (WSMR), New Mexico, on their respective Essential Elements of Analysis (EEA) in conjunction with the COEA Study Plan for use in the MS I Decision Review.

2.2.1 Research of Predecessor Publications. We reviewed all appropriate documentation covering predecessor systems (e.g., HAWK, PATRIOT). The review included a literature search of predecessor system documents such as previous HARDMAN studies, lessons learned, etc. (see **Appendix B** for a complete list of publications and reference materials researched).

2.2.2 Attendance at CORPS SAM ILSMT/MJWG. We also attended several Integrated Logistic Support Management Team (ILSMT) and MANPRINT Joint Working Group (MJWG) meetings. Attendance at these meetings was crucial in keeping abreast of the latest occurrences affecting the CORPS SAM acquisition program and aided in our MPT analyses.

2.2.3 CORPS SAM COEA Study Plan. The MPT analyses was performed in concert with the CORPS SAM COEA Study Plan. We determined MPT requirements for the base case and four alternatives identified in the CORPS SAM COEA Study Plan. Any significant CORPS SAM HFE, System Safety, and Health Hazard issues affecting MPT were also identified and included in the analysis effort (**see Figure 2-2** for CORPS SAM COEA Study Plan Methodology).

2.2.4 COEA Alternatives. In accordance with the COEA Study Plan, dated August 1992, provided by TRAC-SAC, Fort Leavenworth, the following major system alternatives were assessed to determine their impact on MPT resources:

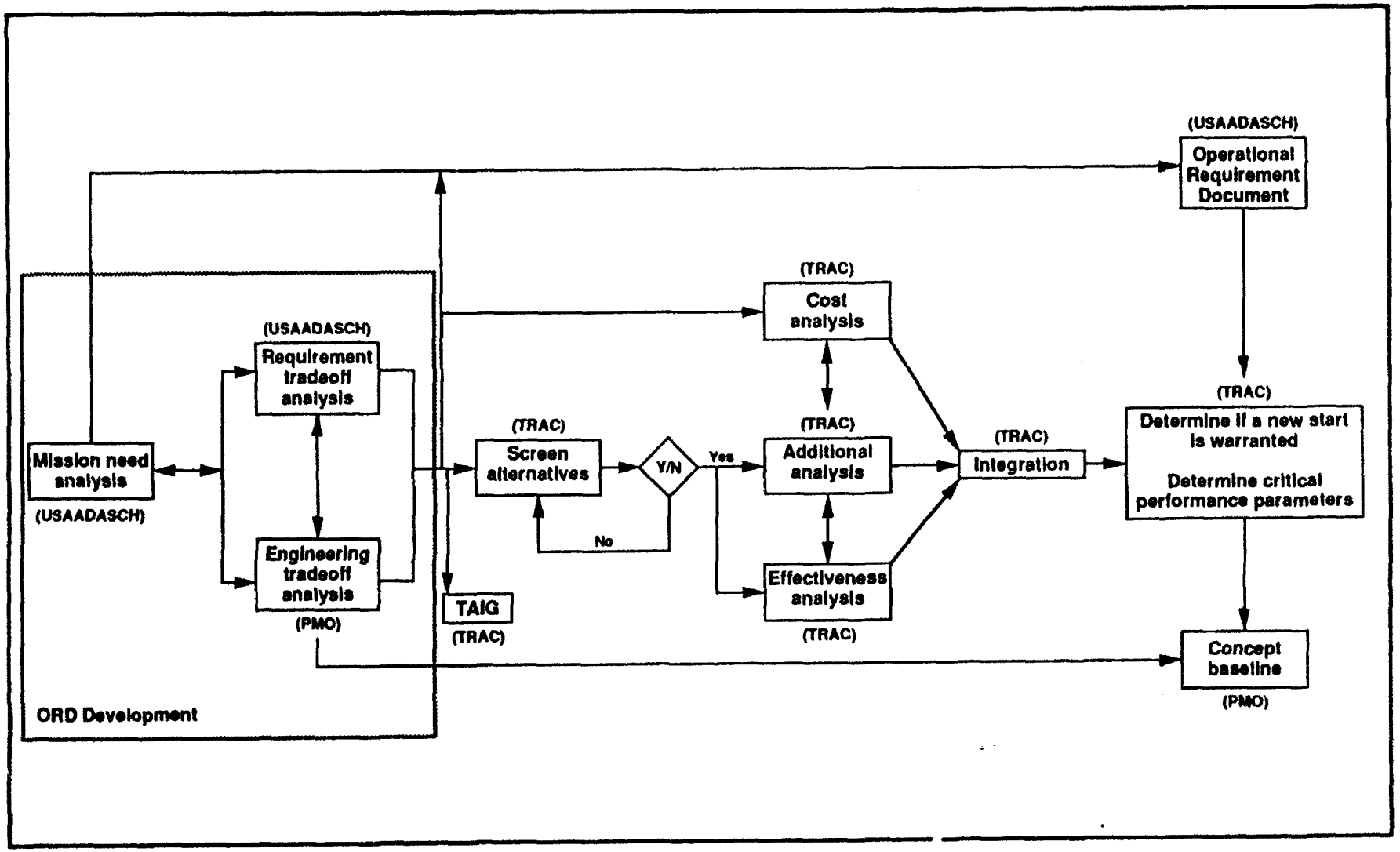


FIGURE 2 - 2

CORPS SAM COEA STUDY PLAN METHODOLOGY

2.2.4.1 Base Case. The current HAWK Phase IIIA system consists of a three missile launcher, High Powered Illuminating (HPI) radar, Platoon Command Post (PCP) fire control, and the Continuous Wave Acquisition Radar (CWAR).

2.2.4.2 Alternative Number 1. Improved HAWK components. Improvement to components of the system beyond those currently planned and funded (i.e., USMC HAWK).

2.2.4.3 Alternative Number 2. PATRIOT Advanced Capabilities-3 (PAC-3) proliferation, configured as follows: multi-mode missile, Phase III radar, and Phase III remote launcher. The PAC-3 program is a series of time release major upgrades defined in the original Pre-Planned Product Improvement, RAM Growth Plan and the Quick Response Program. Each upgrade builds on the previous one.

2.2.4.4 Alternative Number 3. Same as alternative 2, but PAC-3 will be modified to allow ease in transportability using a common launcher equating to a PAC-3 "light."

2.2.4.5 Alternative Number 5. The conceptual CORPS SAM (see Section 1 for the more definitive system description) using the Strawman 6.1 configuration as provided by the CORPS SAM Program Management Office (PMO).

2.2.5 Support for TRAC Agencies. TRAC-FBHN is responsible for the CORPS SAM manpower and force structure impacts of each alternative in accordance with EEA number 13. TRAC-WSMR is responsible for EEA number 14 - the training impacts of each alternative. Our manpower and Training Resource Requirements Analysis (TRRA) will provide MPT results to both agencies and for possible use as source documentation for Milestone I documentation and as an audit trail for COEA reviewers.

2.3 DATA SOURCES AND LIMITATIONS. MPT data for the base case plus four of the alternatives (see **Table 2-1** for a list of the COEA major system alternatives) contained in the COEA Study Plan was collected. The data collection involved requesting specific usage rate and maintenance ratio data for each of the COEA alternatives at the equipment component level. Respective

PMOs were responsible for approval and release of usage rate and maintenance ratio data for each major system alternative in accordance with the COEA Study Plan. All data requests were coordinated through the TRAC Data Manager for certification. There was an absence of mature RAM data for several of the COEA alternatives (e.g., USMC HAWK and PAC-3 "light"). The lack of estimated Class III and IV consumable data was a problem that was eventually rectified. A front-end Logistics Support Analysis Record (LSAR) pertaining to Tasks 201 and 203 was performed by another support contractor. This functional requirements analysis of CORPS SAM subsystems included the construction of a Baseline Comparison System (BCS) and the collection of reasonable Reliability, Availability, and Maintainability (RAM) data. The results were provided to the our MPT analysts and greatly aided our analytical efforts. The Government encouraged the exchange of data among several support contractors to avoid duplicating efforts and providing comprehensive CORPS SAM analysis. The late arrival of data constrained our MPT analysts' ability to verify/ validate the data. The analysts assumed that Government data were valid. Questionable data were reviewed and discussed with the providing organizations. The questionable data were modified based upon these discussions.

2.4 CORPS SAM ANALYSIS METHODOLOGY. The analysis methodology applied to the CORPS SAM system consisted of the following elements (see **Figure 2-3**):

2.4.1 Maintenance Concept. The maintenance concept was obtained from the Integrated Logistic support Plan (ILSP). It defined the maintenance levels and identified responsible maintenance organizations.

2.4.2 Training Concept. The training concept was obtained from the CORPS SAM STRAP. It defined the types of training that will be utilized to support the operation and maintenance of the system, described the training devices that will be utilized in the institutional and unit training courses; and the organizations responsible for the development and conduct of the training courses.

TABLE 2 - 1

COEA MAJOR SYSTEM ALTERNATIVES

Alternatives		System
Base Case	–	HAWK IIIA
Alternative #1	–	Improved HAWK Phase IIIA (USMC)
Alternative #2	–	PAC-3
Alternative #3	–	PAC-3 "light"
Alternative #5	–	CORPS SAM (conceptual)

* Alternative #4, HAWK III A with various types of missiles, was not analyzed at the request of the government.

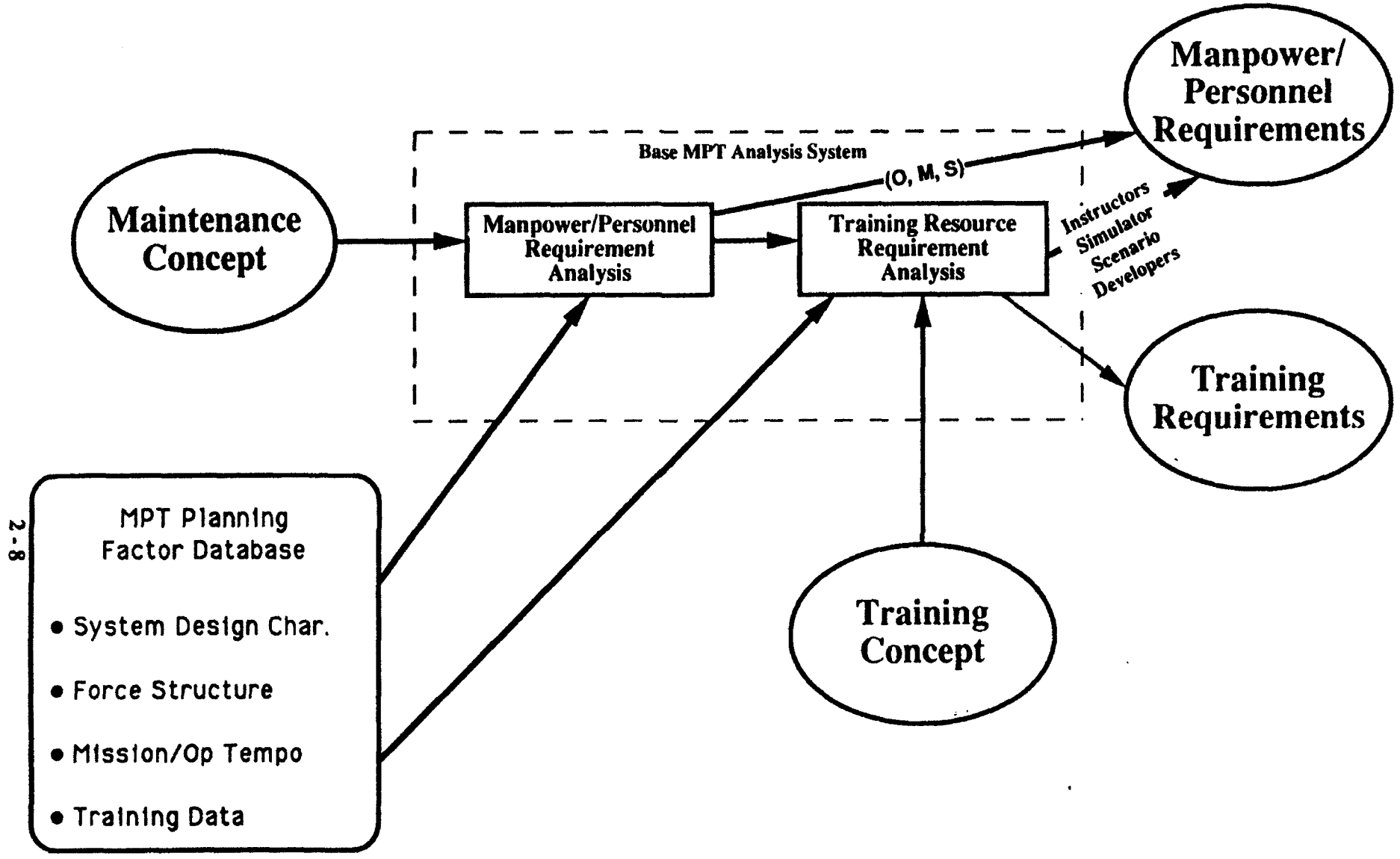


FIGURE 2-3

CORPS SAM ANALYSIS METHODOLOGY

2.4.3 **MPT Planning Factors Database.** This database contains the information necessary to conduct the manpower and training requirements analysis. Most of the input data were in hard copy format. The necessary data elements had to be manually entered into the MPT databases by the analysts.

2.5 MANPOWER AND PERSONNEL ANALYSIS. The manpower and personnel analysis (see **Figure 2-4**) addressed the system specific and all support military manpower requirements by grade and MOS for the base case and each major system alternative described in the COEA Study Plan. This analysis included verification of system specific operator and maintainer MOSs. The analysis began with an extensive data collection effort, obtaining the required Tables of Organization and Equipment (TOEs), associated Basis of Issue Plans (BOIPs), maintenance data for each item of equipment required in each alternative, daily fuel consumption rates, daily ammunition consumption rates, weight per round/missile container, and capacity of ammunition transport equipment. The next step was to apply the BOIPs to the appropriate TOEs to determine the identity and density of all TOE equipment requirements, and to determine the appropriate operator/maintainer identities (i.e., MOS) for each of the COEA alternatives. Once the equipment requirements were identified for each of the alternatives, the maintenance ratios (M/Rs), where available, or Annual Maintenance Man-Hours (AMMHs) and the Equipment Usage Rates were determined by MOS and by maintenance level for each item of equipment. This data was then loaded into the Manpower Requirements Determination (MRD) Model and the AMMH data were converted to M/Rs. Organizational fuel and ammunition transport vehicle requirements were determined by application of the daily fuel consumption rates (e.g., gallons per hour, kilometers per gallon, etc.) by type fuel (e.g., diesel, gasoline), daily ammunition consumption rates, daily tonnage, and vehicle capacity (bulk out or weight out). The maintainer manpower requirements were then calculated for each item of equipment using the standard Army manpower determination algorithms (from AR 570-2) and the revised Manpower Requirements Criteria (MARC) MOS Availability Factors identified in MEMORANDUM HQDA ATTN: MOFI-TED SUBJECT: MARC Wartime Manhour Availability Factors, DATED 30 March, 1992. Standard of Grade Authorizations from AR 611-201 for each MOS

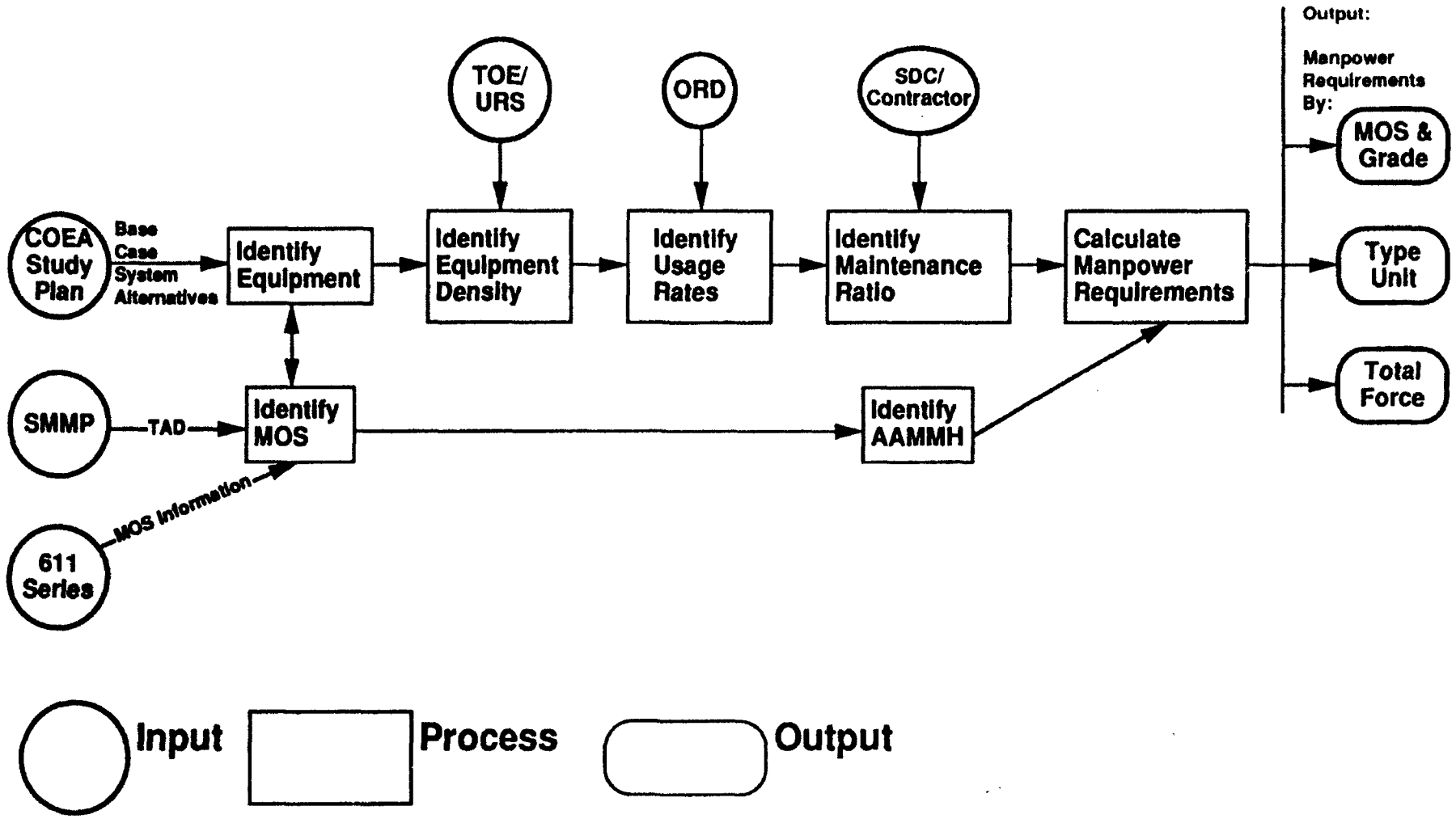


FIGURE 2 - 4

CORPS SAM MANPOWER ANALYSIS

addressed were then loaded into the MRD model and the distribution of manpower by grade for each MOS was determined. The MRD model reports depict the manpower requirements by MOS and grade, by component (Active and National Guard) for each of the COEA alternatives and the Intermediate Direct Support (IDS) unit.

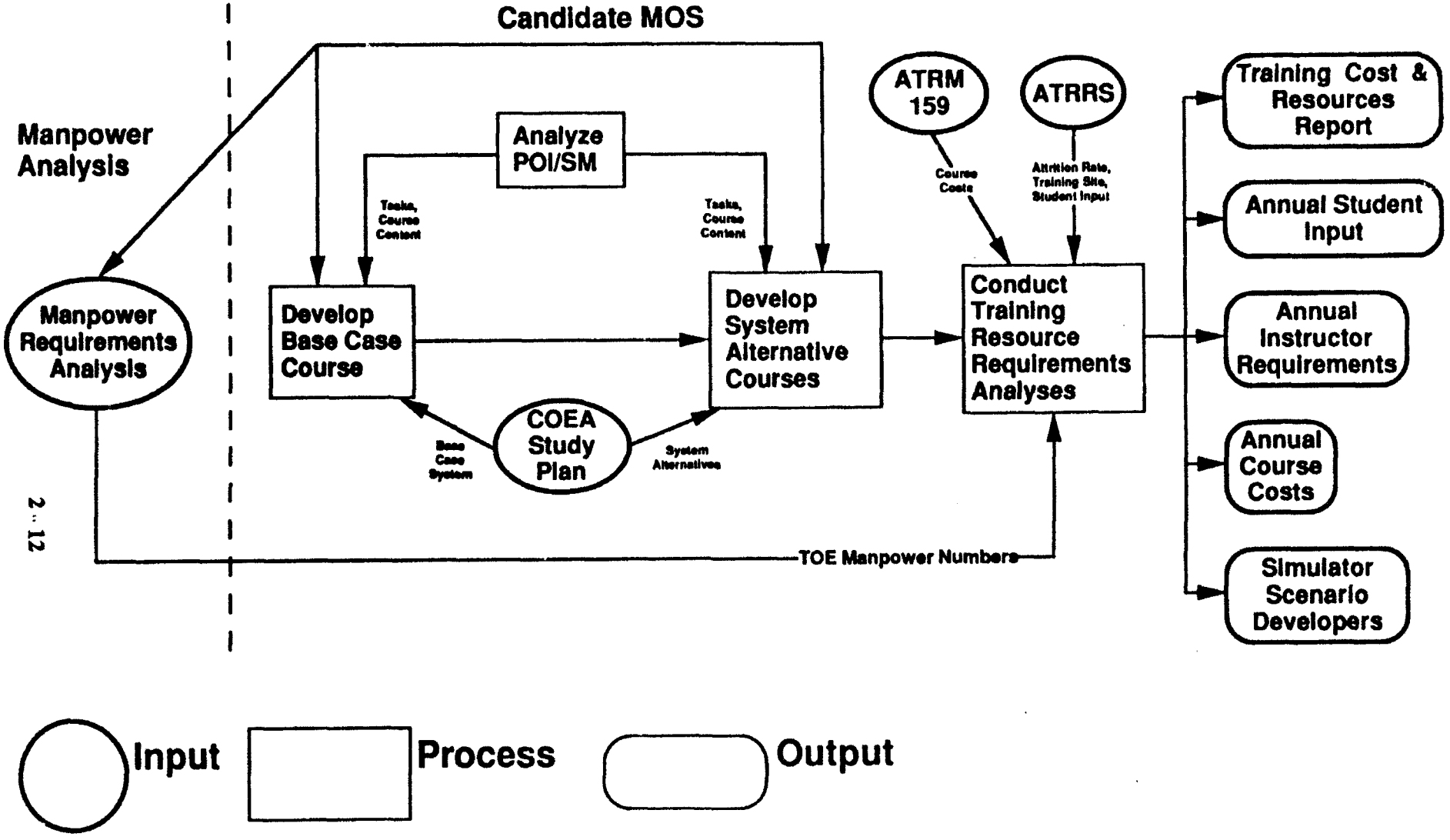
2.6 TRAINING ANALYSIS. The training resource requirements analysis effort included the system specific and support MOSs impacted by the base case and each studied alternative (see **Figure 2-5**). It began with the collection of data necessary to support the analysis effort. Using the Manpower requirements by MOS and Grade list from the manpower analysis effort, tasks from the Soldier's Training Publications (STPs), and course data from the POI the analyst constructed training courses for the base case and each system alternative. The HARDMAN Comparability Methodology and HARDMAN II software was used to calculate the resources required to support each alternative. The results were then compared to the base case resource requirements. TRADOC accepted training cost and resource estimating algorithms were incorporated into the software that supports the HARDMAN analysis. Cost data was obtained from the Army Training Resource Management (ATRM)-159 report. Student attrition rates, training locations, and student inputs were obtained from the Army Training Requirements and Resources System (ATTRS) reports. The following reports are provided from the training analysis effort: A Training Cost and Resources Report (that provides course length, instructor contact hours, type instruction, etc.), the annual student inputs by course, the annual instructor requirements by course, and the annual course costs.

2.6.1 Training Analysis Assumptions. Training analysis assumptions as defined in the STRAP are as follows:

(1) The CORPS SAM system will replace the HAWK system.

(2) CORPS SAM training devices will be computer based and will be centered around the Army Tactical Command and Control System (ATCCS) Common Hardware and Software (CHS) program.

(3) CORPS SAM peculiar equipment will have two



2-12

FIGURE 2-5

CORPS SAM TRAINING ANALYSIS

maintenance levels: Unit and Depot Maintenance.

(4) The quality and skill of the target audience will not increase over that of the HAWK Missile System.

(5) The CORPS SAM system will utilize an operator that will replace the HAWK III operator and maintainer MOSs.

(6) Manpower and equipment resources will be available to support training development over the life-cycle of the system.

2.7 CORPS SAM MANPRINT OBJECTIVES. The CORPS SAM MANPRINT objectives are defined in the SMMP. They are as follows: (1) Personnel required to man, operate, maintain, train, and supply the system must be reduced to obtain a significant operations and support savings over the system life cycle; (2) Reduced manning with enhanced capability will clearly involve increased automation throughout the CORPS SAM operational hardware and support concept. These objectives will require careful assessment and assignment of the soldier-software-hardware interface tasks' requirements and training development.

2.7.1 Human Factors Standards. The CORPS SAM system will conform to applicable HFE military standards to ensure that the human-machine interface (HMI) is consistent with the capabilities and limitations of the operator and maintainer. Additionally, it will provide human to computer interfaces incorporating features that facilitate interactive operator control without precluding automatic engagements.

2.8 OTHER CONSIDERATIONS AFFECTING MPT ANALYSES. Several additional CORPS SAM considerations were encountered during the analysis. These included the following:

2.8.1 COEA Study Plan. The COEA Study Plan that was developed by TRAC-SAC, Fort Leavenworth, was the guiding document for use in determining the alternatives to use for MPT analytical purposes. Note: Alternative number four (HAWK IIIA system with various missile configurations) was not analyzed at the request

TABLE 4-5

of the Government.

2.8.2 Use of Consistent Data. Consistent and accurate manpower data must be used for the COEA for Milestone I since this is a key milestone decision point for the CE&D phase.

2.8.3 New CORPS SAM Operator MOS. The potential for a new CORPS SAM operator MOS received high priority during our MANPRINT risk assessment in order to validate the feasibility of these new MOSs.

2.8.4 Use of Standard Support Manpower. Standard area support in terms of transportation, Explosive Ordnance Disposal (EOD), and the use of a two-level maintenance concept (organization and depot) was used to the maximum extent possible in order to keep support manpower requirements to a minimum.

2.8.5 Other CORPS SAM MPT Analytical Efforts. The CORPS SAM MPT analytical efforts are being dovetailed with several similar efforts covering the family of ground-based air defense systems (i.e., National Missile Defense and THAAD) on a shared Theater Missile Defense (TMD) basis to achieve the best ADA combat capability in the most cost effective manner wherever practical. This MPT analysis was performed with the objective of influencing the design of the CORPS SAM system during the CE&D phase. One of the main objectives of this analysis was to mitigate and minimize people problems such as labor intensive workload, training difficulty and thus avoid creating hazardous conditions to the soldier in the field.

SECTION 3.0

CORPS SAM MANPRINT ISSUES

3.1 SOURCES OF MANPRINT CONCERNS. The CORPS SAM SMMP and ILSP were the major sources for HFE, system safety, and health hazard issues. These have been identified as follows:

(1) Two primary documents of the HFE domain are the HFE Assessment (HFEA) and the System MANPRINT Management Plan (SMMP). The CORPS SAM SMMP is the program's planning/management document for all domains of MANPRINT and contains specific HFE domain issues/concerns that must be addressed throughout the program's life cycle. The SMMP is developed by domain representatives, including HFE, to the MANPRINT Joint Working Group (MJWG). The HFEA is a status review of CORPS SAM's Human Factors Engineering to include soldier performance related issues to determine whether any Critical or Major HFE problem areas/concerns exist which would preclude the transition of the program to the next scheduled phase of the weapon system acquisition life cycle. As appropriate, the HFEA addresses the HFE concerns identified in the SMMP. The HFEA is initiated during the CE&D, Phase 0, and updated prior to each milestone decision review. The SMMP and HFEA serve as the historical record/audit trail for HFE problems. The US Army Research Laboratory (ARL), Human Research & Engineering Directorate (HRED), MICOM Field Element, in coordination with the ARL HRED-USAADASCH Field Element at Fort Bliss, will perform the HFEA. Both representatives also update HFE issues within the SMMP.

(2) The objective of system safety is to maximize operational readiness by application of system safety engineering management and principles to basic technology; ensure modifications of equipment and mission changes do not lessen system safety aspects; identify hazards with the aim toward elimination or, as a lesser objective, ensure that residual risks are appropriately documented, accepted and managed. During the CE&D phase, a System Safety Management Plan (SSMP) will be developed and when complemented by the System Safety Program Plan (SSPP) and the System Safety Working Group

(SSWG) charter, will serve as the driving force(s) to ensure that the objectives of this domain are achieved. System safety representatives will routinely be included in the membership of the MJWG, Configuration Control Board (CCB), and Test Integration Working Group (TIWG). The US Army Safety Center, Fort Rucker, Alabama, in coordination with the Fort Bliss Installation Safety Office, will conduct the Independent Safety Assessment.

(3) The identification of potential hazards associated with the operation and maintenance of CORPS SAM hardware will be the focus of the health hazards assessment. Personnel from The Surgeon General's Office (TSG) and the Army Environmental Hygiene Agency (AEHA) will be key members of the MJWG. Their primary tasks will be to initiate and update the Health Hazard Assessment (HHA), develop hazard test criteria, and document type and severity of health hazards associated with the technologies proposed for the CORPS SAM system. The TSG and AEHA, in coordination with the AEHA representative at William Beaumont Army Medical Center in El Paso, Texas, will conduct the health hazards assessment.

(4) Several HFE, system safety, and health hazards issues from predecessor system deficiencies and/or lessons learned may have a bearing on CORPS SAM MPT requirements. These have been identified for possible mitigation by material solution or training thereby providing a complete "MANPRINT look" at the CORPS SAM materiel system. These lessons learned are as follows:

(a) Human Factors Engineering:

- High levels of crew compartment steady state noise degrades communications and the detection/discrimination of audio alerts/alarms, etc. (HAWK).

- Voice intelligibility of crewmen common links are less that desirable and introduces errors into communications, especially when personnel are in mission oriented protective posture (MOPP) IV conditions.

• Insufficient automation of electronic counter countermeasure (ECCM) capabilities negatively affects operator workload and system performance (HAWK).

• PATRIOT fault isolation capabilities are a problem area, especially for the Radar Set.

• The CORPS SAM design needs to facilitate maintainability features, especially accessibility (PATRIOT/ HAWK).

• System design needs to improve features regarding crew gear storage and transportability of support equipment (PATRIOT/HAWK).

• System design needs to adequately address environmental considerations/crew compartment conditions (i.e., heating, cooling, ventilation, NBC protection/positive over-pressure) (HAWK).

• Units preferred using forklifts for missile reloads over the guided missile transporters (GMTs) because of increased speed (PATRIOT).

• Missiles reload crews experienced difficulties with the GMTs (e.g., slow, unwieldy, and current safety procedures require extensive time to load and unload missiles). Need a safer procedure for combat (PATRIOT).

• Units experienced difficulties in maneuvering through featureless terrain (HAWK/PATRIOT).

• Units experienced difficulties in reducing the Air Force airspace control orders (ACOs) (HAWK/PATRIOT).

• Units experienced video display difficulties with positive identification of aircraft (HAWK).

(b) System Safety:

• GMTs were dangerous at times (PATRIOT).

(c) Health Hazards:

• Personnel exposure to radio frequency (RF) radiation occurred frequently.

3.2 CORPS SAM HUMAN FACTORS ENGINEERING, SYSTEM SAFETY AND HEALTH HAZARDS AFFECTING MPT RESOURCES. The AEPCO/DRC MPT assessment has attempted to influence the design of the CORPS SAM system during the CE&D phase in order to mitigate and minimize people aspects such as soldier/hardware interface and to ensure that the system hardware is hazard free and safe to operate and maintain by eliminating hazardous conditions to the soldier in the field. The most up-to-date data affecting MPT has been incorporated into the analysis as empirical data becomes available. The following are several of the MANPRINT issues surfaced by this MPT analysis that have an indirect effect on MPT resources and should be further investigated for resolvement by USAADASCH:

(1) There are potential people categorization problems associated with the new CORPS SAM operator MOS. The heavy reliance and MANPRINT risks associated on the Built-in Test/ Built-in Test Equipment (BIT/BITE) of 100% accuracy 95% of the time is evident. There appears to be potential problems associated with increased throwaways due to the remove and replace policy inherent in the two-level maintenance policy causing environmental and safety problems.

(2) The workload effects of continuous operations on operators and maintainers.

(3) The potential conflicts which could arise between maintenance and operations personnel over who has ultimate responsibility for equipment maintenance.

(4) The lack of organic manpower support for the unit maintainer if unable to restore the CORPS SAM system to operational status.

In summation, although a group of senior system operators will be located in the Headquarters Battery, no other training is

envisioned to increase the maintenance skills of these senior system operators. Several MANPRINT concerns are raised when this maintenance concept is evaluated once it is understood what training will be provided to the system operator.

(1) What is the mission impact if the system operator is unable to initialize the CORPS SAM system? How will the operator be able to determine the fault if he is unable to run diagnostics?

(2) What is the mission impact if Test Measurement and Diagnostic Equipment indicates not only that a replaced BRU is faulty but reveals that another BRU item is faulty as well? Will faulty BRUs be tested prior to disposition? If so, who will test the BRUs?

(3) What is the mission impact if the system and/or senior operators are unable to correct the fault? Will the entire subsystem be sent to depot for repair? If so, who will remove and replace the subsystem?

SECTION 4.0

MANPOWER AND PERSONNEL REQUIREMENTS ANALYSIS

4.1 OVERVIEW. The objective of the CORPS SAM COEA Manpower and Personnel Requirements Analysis was to identify, using the best available data, the total Army manpower requirements by MOS and grade, by component (Active Army and National Guard) for each of the COEA alternatives and the supporting Intermediate Direct Support (IDS) Maintenance Company.

4.2 MANPOWER AND PERSONNEL ANALYSIS ASSUMPTIONS AND CONSTRAINTS. The following assumptions and constraints were applied to the manpower and personnel analysis:

- Manpower requirements were determined for system specific operators, maintainers, and support personnel.

- CORPS SAM system specific equipment was designed for a Two-Level Maintenance Concept. All other unit equipment was anticipated to be operated under the current U.S. Army maintenance concept.

- MOS 23R workload was reduced to removal and replacement of Line Replaceable Units (LRUs) and transferred to the new 14X operator MOS.

- MOS 23R was eliminated.

- BIT/BITE for CORPS SAM systems was planned to be 100% accurate 95% of the time.

- 70% of LRUs were considered throw-away with the remaining 30% assumed repairable at Depot level.

- Supply operations will continue under the current three-level concept.

- The IDS Maintenance Company (HAWK), Standard Requirements Code (SRC) 09497L maintains only HAWK system

specific equipment and supporting air conditioning and power generation equipment.

- Manpower requirements were calculated for a wartime 100% manning level.

- The Standard of Grade Authorization (SGA) criteria from AR 611-201 for MOS 14D was used to determine the grade distribution for MOS 14X for the CORPS SAM and for 14D for the USMC HAWK alternatives.

- SGA criteria from AR 611-201 for MOS's 16T and 24T were used for the PAC-3 and PAC-3 "Light" alternatives.

- Manpower requirements were not be constrained by Army of Excellence (AOE) guidance.

- The Base Case source documents were Table of Organization and Equipment (TOE) SRC 44495L and the associated Basis of Issue Plans (BOIPs) for a HAWK III Battalion 4 x 2.

- The Force Structure used for this analysis was:

FORCE STRUCTURE	ACTIVE	GUARD	TOTAL
ALL ALTERNATIVES	3 BN	5 BN	8 BN
BATTERIES PER BN	HHB	ADA	
BASE CASE	1	3	
ALL ALTERNATIVES	1	4	
LAUNCHERS PER BATTERY ALL		8	

- For consistency purposes, each alternative was configured as a four battery battalion allowing for an "apples-to-apples" comparison of the alternatives.

- The battalion was considered operational 24 hours a day.

- Manpower calculations were accomplished using the best available data as provided by the government and the Standard Army Manpower Determination Algorithms.

• The Usage Rate for system specific equipment was 8760 hours per year. All other equipment Usage Rates were the Army Standard.

4.2.1 Personnel Assumptions and Constraints.

• Manpower requirements were expected to be supported consistent with current authorizations and operating personnel strength levels of support.

• For the purposes of this study, the CORPS SAM Operator MOS was designated as MOS 14X.

• MOS 14D Target Audience Description was used for MOS 14X (CORPS SAM) and MOS 14D (USMC HAWK) physical and mental attributes.

4.3 MANPOWER REQUIREMENTS (Tables 4-1 through 4-8)

The manpower requirements reports for each of the alternatives compares that alternative to the base case. The results are displayed in recapitulation format with appropriate header information for each alternative. For example, in Tables 4-1 through 4-4, the data is arrayed in 4 columns labeled A through D; Column A: HAWK III TOE; B: HAWK III TRUE REQ; C: PROJECTED (ALTERNATIVE); D: DELTA (C - A). In Tables 4-5 through 4-8, the data is arrayed in 4 columns labeled A through D; Column A: HAWK III TOE; B: HAWK III SYS SPECIFIC; C: PROJECTED (ALTERNATIVE); D: DELTA (C - B).

4.4 BASE CASE - HAWK III. The manpower requirements identified for the Base Case system were extracted from the TOE SRC 44495L, Air Defense Battalion (HAWK III) and adjusted to reflect the changes associated with the applicable BOIPs. In addition to the Base Case, the manpower requirements report also provides a HAWK III "TRUE REQUIREMENTS" column. This analysis provides the manpower requirements for HAWK III unconstrained by AOE and calculated using the latest wartime availability factors. This is provided for comparison purposes only.

TABLE 4 - 1

ADA BATTALION CORPS SAM MANPOWER REQUIREMENTS

NUMBER OF UNITS	ACTIVE	GUARD	TOTAL
	3	5	8

THE MANPOWER INFORMATION PROVIDED BELOW IS FOR A SINGLE UNIT

	(A)	(B)	(C)	(D)
PERSONNEL CATEGORY	HAWK III TOE	HAWK III TRUE REQ	PROJECTED CORPS SAM	DELTA
OFFICER	43	43	44	1
WARRANT	12	12	14	2
ENLISTED ADA	186	199	232	46
OTHER ENLISTED	256	237	217	-39
UNIT TOTAL	497	491	507	10

TABLE 4 - 2

ADA BATTALION PAC - 3
MANPOWER REQUIREMENTS

NUMBER OF UNITS	ACTIVE	GUARD	TOTAL
	3	5	8

THE MANPOWER INFORMATION PROVIDED BELOW IS FOR A SINGLE UNIT

	(A)	(B)	(C)	(D)
PERSONNEL CATEGORY	HAWK III TOE	HAWK III TRUE REQ	PROJECTED PAC-3	DELTA
OFFICER	43	43	51	8
WARRANT	12	12	15	3
ENLISTED ADA	186	199	157	-29
OTHER ENLISTED	256	237	321	65
UNIT TOTAL	497	491	544	47

TABLE 4 - 3

ADA BATTALION PAC - 3 "LIGHT" MANPOWER REQUIREMENTS

NUMBER OF UNITS	ACTIVE	GUARD	TOTAL
	3	5	8

THE MANPOWER INFORMATION PROVIDED BELOW IS FOR A SINGLE UNIT

	(A)	(B)	(C)	(D)
PERSONNEL CATEGORY	HAWK III TOE	HAWK III TRUE REQ	PROJECTED PAC-3 "LT"	DELTA
OFFICER	43	43	51	8
WARRANT	12	12	15	3
ENLISTED ADA	186	199	157	-29
OTHER ENLISTED	256	237	321	65
UNIT TOTAL	497	491	544	47

TABLE 4 - 4

ADA BATTALION USMC HAWK MANPOWER REQUIREMENTS

NUMBER OF UNITS	ACTIVE	GUARD	TOTAL
	3	5	8

THE MANPOWER INFORMATION PROVIDED BELOW IS FOR A SINGLE UNIT

PERSONNEL CATEGORY	(A) HAWK III TOE	(B) HAWK III TRUE REQ	(C) PROJECTED USMC HAWK	(D) DELTA
OFFICER	43	43	51	8
WARRANT	12	12	15	3
ENLISTED ADA	186	199	221	35
OTHER ENLISTED	256	237	264	8
UNIT TOTAL	497	491	551	54

TABLE 4-5

DS MAINT CO. CORPS SAM MANPOWER REQUIREMENTS

NUMBER OF UNITS	ACTIVE 4	GUARD 4	TOTAL 8

THE MANPOWER INFORMATION PROVIDED BELOW IS FOR A SINGLE UNIT

PERSONNEL CATEGORY	(A) HAWK III TOE	(B) HAWK III SYS SPECIFIC	(C) PROJECTED CORPS SAM	(D) DELTA
OFFICER	3	0	0	0
WARRANT	4	0	0	0
ENLISTED ADA	61	51	0	-51
OTHER ENLISTED	77	6	3	-3
UNIT TOTAL	145	57	3	-54

5.5.3 Alternative 2. The COEA Study Plan identified the PATRIOT

TABLE 4 - 6

DS MAINT CO. PAC - 3
MANPOWER REQUIREMENTS

NUMBER OF UNITS	ACTIVE	GUARD	TOTAL
	4	4	8

THE MANPOWER INFORMATION PROVIDED BELOW IS FOR A SINGLE UNIT

	(A)	(B)	(C)	(D)
PERSONNEL CATEGORY	HAWK III TOE	HAWK III SYS SPECIFIC	PROJECTED PAC-3	DELTA
OFFICER	3	0	0	0
WARRANT	4	0	0	0
ENLISTED ADA	61	51	5	-46
OTHER ENLISTED	77	6	7	1
UNIT TOTAL	145	57	12	-45

TABLE 4 - 7

DS MAINTENANCE CO. PAC - 3 "LIGHT" MANPOWER REQUIREMENTS

NUMBER OF UNITS	ACTIVE	GUARD	TOTAL
	4	4	8

THE MANPOWER INFORMATION PROVIDED BELOW IS FOR A SINGLE UNIT

	(A)	(B)	(C)	(D)
PERSONNEL CATEGORY	HAWK III TOE	HAWK III SYS SPECIFIC	PROJECTED PAC-3 "LT"	DELTA
OFFICER	3	0	0	0
WARRANT	4	0	0	0
ENLISTED ADA	61	51	5	-46
OTHER ENLISTED	77	6	7	1
UNIT TOTAL	145	57	12	-45

TABLE 4 - 8

DS MAINTENANCE CO. USMC HAWK MANPOWER REQUIREMENTS

NUMBER OF UNITS	ACTIVE	GUARD	TOTAL
	4	4	8

THE MANPOWER INFORMATION PROVIDED BELOW IS FOR A SINGLE UNIT

	(A)	(B)	(C)	(D)
PERSONNEL CATEGORY	HAWK III TOE	HAWK III SYS SPECIFIC	PROJECTED USMC HAWK	DELTA
OFFICER	3	0	0	0
WARRANT	4	0	0	0
ENLISTED ADA	61	51	43	-8
OTHER ENLISTED	77	6	5	-1
UNIT TOTAL	145	57	48	-9

4.5 CORPS SAM. The manpower requirements for CORPS SAM systemspecific equipment were calculated using the maintenance ratios or Annual Maintenance Man-Hours (AMMHs) provided by the CORPS SAM PMO. The elimination of MOS 23R along with the majority of the 23R workload together with the combining of the operator and maintainer tasks into one MOS (14X Operator) was the predominant factor in reducing the operator manpower requirements per battery. However, these savings are negated by an overall increase in new CORPS SAM operators caused by the addition of another ADA battery. Significant 14X MOS manpower is dedicated to non-system specific positions such as vehicle drivers, staff, and supervisory positions. Some manpower savings was achieved by reducing the number of Man-Portable Air Defense System (MANPADS) teams, reduction of multi-channel communications positions, and upgrade of wheel vehicles and radios to less maintenance intensive equipment (e.g., MTV, LMTV, and SINCGARS) equipment. Overall the total manpower requirements are slightly higher than the current HAWK III manpower requirements (HAWK III's 497 vs. CORPS SAM's 507). This can be attributed to the additional ADA battery and not to the workload demands of the new system.

4.6 COEA ALTERNATIVE SYSTEM MANPOWER REQUIREMENTS

4.6.1 PAC-3. The manpower requirements for the PAC-3 alternative system were determined using maintenance ratio or AMMHs provided by the government or extracted from the Army MARC Data Base. For consistency purposes, the PAC-3 Battalion was configured using the same organizational structure as the CORPS SAM Battalion, with PAC-3 system specific equipment substituted for CORPS SAM. Operator (MOS 16T) and maintainer (MOS 24T) manpower requirements for PAC-3 are slightly higher than those of the Base Case and require significant increases in support equipment operator and maintainer MOS's, particularly in wheel vehicle maintenance (HEMMT vs. FMTV) and fuel transport operators. Additionally, the PAC-3 system would require DS Maintenance in excess of that currently required by the Base Case system (HAWK III).

4.6.2 PAC-3 "Light". The manpower requirements for the PAC-3 "Light" alternative system were determined using maintenance ratio or AMMHs provided by the government or extracted from the Army MARC Data Base. For consistency purposes, the PAC-3 "Light" Battalion was configured using the same organizational structure as the CORPS SAM Battalion, with PAC-3 "Light" system specific equipment substituted for CORPS SAM. Operator (MOS 16T) and maintainer (MOS 24T) manpower requirements for PAC-3 "Light" are slightly higher than those of the Base Case and require significant increases in support equipment operator and maintainer MOS's, particularly in wheel vehicle maintenance (Heavy Equipment Mobile Tactical Transport vs. Family of Medium Tactical Vehicles) and fuel transport operators. The replacement of the PAC-3 Launcher with the PAC-3 "Light" Launcher had no impact on maintainer requirements. Additionally, the PAC-3 "Light" system would require DS Maintenance in excess of that currently required by the Base Case system (HAWK III).

4.6.3 USMC HAWK. The manpower requirements for the USMC HAWK alternative system were determined using AMMHs extracted from the Army MARC Data Base. For consistency purposes, the USMC HAWK Battalion was configured using the same organizational structure as the CORPS SAM Battalion, with USMC HAWK system specific equipment substituted for CORPS SAM. Operator (MOS 14D) and maintainer (MOS 23R) manpower requirements for USMC HAWK are higher than those of the Base Case and a DS Maintenance requirement in excess of that currently required by the Base Case system (HAWK III) primarily due to the additional battery.

4.7 INTERMEDIATE DIRECT SUPPORT MAINTENANCE COMPANY. The format for the IDS analysis differs slightly from that of the ADA Battalion. Columns B and C display only the manpower requirements for the system specific, air conditioning, and power generation equipment. All other manpower requirements in the unit are there to support IDS organic equipment. The two level maintenance concept for CORPS SAM virtually eliminates the need for a dedicated IDS unit. The maintenance workload required for supporting the air conditioning and power generation equipment could be provided by other CORPS IDS maintenance units. The PAC-3, PAC-3 "Light", and USMC HAWK

alternative systems would still require IDS maintenance companies for system specific equipment, air conditioning and power equipment support.

SECTION 5.0

TRAINING RESOURCE REQUIREMENTS ANALYSIS

5.1 PURPOSE AND SCOPE. The CORPS SAM TRRA determined the resource requirements for the base case and four COEA alternatives as defined in the COEA study Plan. The TRRA also, determined impacts of an operator MOS for the CORPS SAM system that will conduct computer aided diagnostics and removal and replacement of Battery Replacement Units (BRUs). The TRRA included all system specific and primary support MOSs. The sources of information for determining the MOSs impacted by this MPT analysis included the CORPS SAM SMMP, System Training Plan (STRAP), the programs of instruction (POIs) listed in **Appendix B**, AR 611-201, Enlisted Career Management Fields and Military Occupational Specialties, and DA Pam 351-4, U.S. Army Formal Schools Catalog.

5.2 ASSUMPTIONS. The following assumptions were used as guidelines during the TRRA:

(1) The training proposed for each alternative will replace the courses currently being conducted in support of the HAWK III system.

(2) CORPS SAM operator training will replace the following courses:

- HAWK Missile System Crewmember (043-14D10)
- HAWK Missile System Crewmember BNCOC (043-14D30)
- HAWK Missile System Mechanic (121-23R10)
- HAWK Missile System Mechanic BNCOC (121-23R30)
- HAWK Firing Section Repairer (121-27H10)
- HAWK Firing Section Repairer (BNCOC) (121-27H30)
- HAWK Field Maint EQ/PAR Repairer (104-27J10)
- HAWK Field Maint EQ/PAR Repairer (BNCOC) (104-27J10)
- HAWK Fire Control/CWAR Repairer (104-27K10)
- HAWK Fire Control/CWAR Repairer (BNCOC) (104-27K30)

(3) Embedded training will be incorporated into each alternative.

(4) The TRRA included enlisted MOSs only.

(5) The optimum class size for the CORPS SAM operator's training course will be 15.

(6) A student-to-instructor ratio of 15 to 1 will be used for all CORPS SAM operator training classes conducted on a training simulator.

5.3 AUDIT TRAIL. **Table 5-1** contains a listing of the courses and that were included in the analysis. The table reflects the type of impact, content change or student input change, for each course. **Table 5-2** contains a listing of the audit trail documentation for the analytical effort. Requests for copies of the audit trail information may be forwarded to Headquarters TRADOC Analysis Command, Building 401, ATRC-B, Fort Benjamin Harrison, Indiana 46216-5000. This information is a compilation of reports generated from the HARDMAN II software, analyst developed spreadsheets, and Government furnished data.

5.4 METHODOLOGY AND MODEL. Training resource requirements were determined by utilizing the system's manpower requirements to compute the annual student input for each course. Historical manpower and annual student input data was used to compute a ratio of manpower versus annual student input for each training course. This ratio was applied to the base case's and each alternative's manpower requirements to compute the annual student input. Due to the downsizing effort currently underway across the US Army, the training analyst utilized FY 1991 as the base year for computing the annual student inputs. It appeared that the FY 1991 data best represented what the future ADA community would require for a training base. Using comparability analysis, existing training courses were modified or new courses were developed for each alternative. The annual student inputs, ICH, and the course lengths were used to compute the Annual Training Man-Days, Annual Instructor requirements, and Annual Course Cost requirements. The TRADOC approved HARDMAN II model was used to determine the training resource requirements. This model is TRADOC approved and uses ATRM-159 cost data and ATTRS annual course graduate and attrition data in the computation of training resource requirements.

Table 5 - 1. Matrix Showing Course Content and Student Load Impacts by System

COURSES	BASECASE (Hawk III)	ALT 1 (I-Hawk III, USMC)	ALT 2 (PAC-3)	ALT 3 (PAC-3, Light)	ALT 5 Corps SAM
043-14D10	CAB	SL	N/A	N/A	N/A
043-14D30	CAB	SL	N/A	N/A	N/A
104-27J10	CAB	SL	N/A	N/A	N/A
104-27J30	CAB	SL	N/A	N/A	N/A
104-27K10	CAB	SL	N/A	N/A	N/A
104-27K30	CAB	SL	N/A	N/A	N/A
121-23R10	CAB	SL	N/A	N/A	N/A
121-23R30	CAB	SL	N/A	N/A	N/A
121-27H10	CAB	SL	N/A	N/A	N/A
121-27H30	CAB	SL	N/A	N/A	N/A
043-16T10	N/A	N/A	SL	SL	N/A
043-11-16T30	N/A	N/A	SL	SL	N/A
632-24T10	N/A	N/A	SL	SL	N/A
632-24T30	N/A	N/A	N/A	SL	N/A
XXX-14X10	N/A	N/A	N/A	N/A	CC/SL
XXX-14X30	N/A	N/A	N/A	N/A	CC/SL
0-16-C42	CAB	SL	SL	SL	SL
015-25L10	CAB	SL	SL	SL	SL
015-25L30	CAB	SL	SL	SL	SL
610-63B10	CAB	SL	SL	SL	SL
610-63B30	CAB	SL	SL	SL	SL
610-63S10	CAB	SL	SL	SL	N/A
611-63Y10	CAB	SL	N/A	N/A	N/A
662-52D10	CAB	SL	SL	SL	SL
690-52C10	CAB	SL	SL	SL	SL

CAB - No Impact, Included as Comparability Analysis Baseline
CC/SL - Course Change/Student Load Change
N/A - Non Applicable
SL - Student Load Change

Table 5-2

TRAINING RESOURCE REQUIREMENTS ANALYSIS AUDIT TRAIL

THE TRRA AUDIT TRAIL CONSISTS OF THE FOLLOWING DOCUMENTS:
1. **COURSE MODULE REPORTS FOR THE CORPS SAM SPECIFIC TRAINING COURSES.** THE COURSE MODULE REPORTS SHOW THE TYPE OF INSTRUCTION, HOURS OF INSTRUCTION, AND GROUP SIZE FOR EACH TRAINING COURSE.
2. **TRAINING COURSE RESOURCE REPORTS FOR ALL TRAINING COURSES THAT WERE ANALYZED FOR THE BASE CASE AND EACH SYSTEM ALTERNATIVE.** THE TRAINING COURSE RESOURCE REPORTS PROVIDED THE FACTORS THAT IMPACT THE RESOURCES OF EACH COURSE AND ARE AS FOLLOWS: -- ANNUAL SYSTEM SPECIFIC COURSE GRADUATES -- ANNUAL NON-SYSTEM SPECIFIC COURSE GRADUATES -- INSTRUCTOR CONTACT HOURS -- COURSE LENGTH -- OPTIMUM CLASS SIZE
3. **ANNUAL STUDENT INPUT AND SYSTEM SPECIFIC COURSE GRADUATE WORKSHEETS FOR ALL COURSES ANALYZED FOR THE BASE CASE AND EACH SYSTEM ALTERNATIVE.**

5.5 RESOURCE ESTIMATES. The training resource requirements are based upon manpower projections provided by the manpower analyst. These manpower projections will produce Annual Student Inputs that are different from the actual student inputs which are based on "real-world" realities such as down sizing efforts. However, they do allow for an "apples-to-apples" comparison for the analysis. Three types of resource information were determined: Annual Training Man-Days; Annual Instructor Requirements; and Annual Course Costs.

- **Annual Training Man-Days.** The number of days of training per year that are required to support a weapon system. For non-weapon system specific courses, the student input requirements are computed using only the manpower that will support the weapon system and not the entire MOS. They are displayed by course and as a total for each system.

• **Annual Instructor Requirements.** The number of instructors per year required for each course taught in support of a weapon system. For non-weapon system specific courses, the instructor requirements are computed against only the number of students that will support the weapon system not the entire student population. They are displayed by course and as a total for each system.

• **Annual Course Costs.** The cost per year for each course taught in support of a weapon system. For non-weapon system specific courses, the cost is computed against only the number of students that will support the weapon system not the entire student population. They are displayed by course and as a total for each system.

5.5.1 Base Case. The COEA Study Plan identified the HAWK III system as the base case for comparability purposes. The resources for the HAWK III system are contained in **Table 5-3.** There are currently 10 courses that provide training to the operators and maintainers of the HAWK III system. Additionally, there are nine courses that provide training to MOSs that directly support the HAWK III system. The total Annual Training Man-Days for the HAWK III system are 102,812. The total Annual Instructor Requirements for the HAWK III system are 115. The total Annual Course Costs for the HAWK III system is $28,982,000 ($28,982 (K)).

5.5.2 Alternative 1. The COEA Study Plan identified the Improved HAWK III (USMC HAWK III) system as Alternative 1. The resources for the USMC HAWK III system are contained in **Table 5-4.** Ten courses would provide training to the operators and maintainers of the USMC HAWK III system. Additionally, there would be nine courses that provide training to MOSs that directly support the USMC HAWK III system. The total Annual Training Man-Days for the USMC HAWK III system are 135,289. The total Annual Instructor Requirements for the USMC HAWK III system are 147. The total Annual Course Cost for the USMC HAWK III system is $35,494,000 ($35,494 (K)).

TABLE 5 - 3

HAWK III
ANNUAL COURSE RESOURCES

MOS	COURSE NUMBER	COURSE MAN-DAYS	INSTRUCTORS	COURSE COSTS ($K)
ADA	0-16-C42 (CMF 16)	1,351	1	279
14D	043-14D30	5,772	5	1,564
14D	043-14D10	10,640	12	1,836
23R	121-23R10	30,326	31	9,019
23R	121-23R30	897	1	278
25L	150-25L10	2,176	2	450
25L	150-25L30	117	1	47
27J	104-27J10	3,864	5	3,106
27J	104-27J30	612	1	202
27K	104-27K10	21,735	25	4,582
27K	104-27K30	980	1	303
35Y	198-35Y10	6,440	10	1,583
27H	121-27H10	7,644	11	3,079
27H	121-27H30	1,072	1	608
52C	662-52C10	1,794	2	415
52D	662-52D10	2,548	2	692
63B	610-63B30	1,108	1	309
63B	610-63B10	2,912	1	463
63S	610-63S10	412	1	68
63Y	611-63Y10	412	1	99
	TOTALS:	**102,812**	**115**	**28,982**

TABLE 5 - 4

USMC HAWK
ANNUAL COURSE RESOURCES

MOS	COURSE NUMBER	COURSE MAN-DAYS	INSTRUCTORS	COURSE COSTS ($K)
ADA	0-16-C42 (CMF 16)	1,528	1	315
14D	043-14D10	10,850	12	1,853
14D	043-14D30	5,850	5	1,585
23R	121-23R10	57,915	56	15,017
23R	121-23R30	1,716	2	505
25L	150-25L10	1,995	2	412
25L	150-25L30	117	1	47
27J	104-27J10	6,762	7	3,481
27J	104-27J30	714	1	278
27K	104-27K10	18,900	22	4,168
27K	104-27K30	910	1	281
35Y	198-35Y10	6,440	10	1,583
27H	121-27H10	14,112	19	4,045
27H	121-27H30	1,608	2	654
52C	662-52C10	560	1	130
52D	662-52D10	1,315	1	357
63B	610-63B10	2,160	1	343
63B	610-63B30	767	1	214
63S	611-63S10	412	1	68
63Y	610-63Y10	658	1	158
	TOTALS:	**135,289**	**147**	**35,494**

5.5.3 Alternative 2. The COEA Study Plan identified the PATRIOT Advanced Capability-3 (PAC-3) system as Alternative 2. The resources for the PAC-3 system are contained in **Table 5-5**. Five courses would provide training to the operators and maintainers of the PAC-3 system. Additionally, there are five courses that would provide training to MOSs that directly support the PAC-3 system. The total Annual Training Man-Days for the PAC-3 system are 55,197. The total Annual Instructor Requirements for the PAC-3 system are 62. The total Annual Course Costs for the PAC-3 system are $12,546,000 ($12,546 (K)).

5.5.4 Alternative 3. The COEA Study Plan identified the PAC-3 "Light" system as Alternative 3. The resource requirements for the PAC-3 and PAC-3 "Light" are the same because the modifications to the PAC-3 system to change it into the "Light" configuration will not change the system manpower requirements or courses in the training base. The resources for the PAC-3 "Light" system are contained in **Table 5-6**. Five courses would provide training to the operators and maintainers of the PAC-3 "Light" system. Additionally, there are five courses that would provide training to MOSs that directly support the PAC-3 "Light" system. The total Annual Training Man-Days for the PAC-3 "Light" system are 55,197. The total Annual Instructor Requirements for the PAC-3 "Light" system are 62. The total Annual Course Costs for the PAC-3 "Light" system are $12,546,000 ($12,546 (K)).

5.5.4 Alternative 5. The COEA Study Plan identified the CORPS SAM system as Alternative 5. The resources for the CORPS SAM system are contained in **Table 5-7**. Two courses will provide training to the operators of the CORPS SAM system. Additionally, there would be four courses that provide training to MOSs that directly support the CORPS SAM system. The total Annual Training Man-Days for the CORPS SAM system are 65,236. The total Annual Instructor Requirements for the CORPS SAM system are 43. The total Annual Course Costs for the CORPS SAM system are $9,610,000 ($9,610 (K)).

5.6 IMPACT ANALYSIS. In this section a comparison will be made between the Base Case (HAWK III) and the four COEA alternatives. Pertinent training resource requirements high-drivers have been identified and will be discussed.

TABLE 5 - 5

PAC - 3
ANNUAL COURSE RESOURCES

MOS	COURSE NUMBER	COURSE MAN-DAYS	INSTRUCTORS	COURSE COSTS ($K)
ADA	0-16-C42 (CMF 16)	1,410	1	291
16T	043-16T10	17,017	21	3,409
16T	043-11-16T30	2,184	2	988
24T	632-24T10	25,536	29	5,699
24T	632-24T30	975	2	347
27X	121-27X2/3/4	343	1	196
52C	662-52C10	1,009	1	233
52D	662-52D10	1,891	2	513
63B	610-63B10	2,254	1	358
63B	610-63B30	767	1	214
63S	610-63S10	1,811	1	298
	TOTALS:	**55,197**	**62**	**12,546**

TABLE 5 - 6

PAC - 3 "LIGHT"
ANNUAL COURSE RESOURCES

MOS	COURSE NUMBER	COURSE MAN-DAYS	INSTRUCTORS	COURSE COSTS ($K)
ADA	0-16-C42 (CMF 16)	1,410	1	291
16T	043-16T10	17,017	21	3,409
16T	043-11-16T30	2,184	2	988
24T	632-24T10	25,536	29	5,699
24T	632-24T30	975	2	347
27X	121-27X2/3/4	343	1	196
52C	662-52C10	1,009	1	233
52D	662-52D10	1,891	2	513
63B	610-63B10	2,254	1	358
63B	610-63B30	767	1	214
63S	610-63S10	1,811	1	298
	TOTALS:	**55,197**	**62**	**12,546**

TABLE 5 - 7

CORPS SAM
ANNUAL COURSE RESOURCES

MOS	COURSE NUMBER	COURSE MAN-DAYS	INSTRUCTORS	COURSE COSTS ($K)
ADA	0-16-C42 (CMF 16)	1,586	1	327
14X	XXX-14X10	50,675	31	5,841
14X	XXX-14X30	8,385	7	2,446
52C	662-52C10	785	1	181
52D	662-52D10	1,151	1	312
63B	610-63B10	1,972	1	313
63B	610-63B30	682	1	190
	TOTALS:	**65,236**	**43**	**9,610**

5.6.1 Alternative 1 (USMC HAWK III). The training resource requirements for the USMC HAWK III system increase when compared to the Base Case (HAWK III). The total Annual Training Man-Days increased 31.6% from 102,812 to 135,289; the total Annual Instructor Requirements increased 27.8% from 115 to 147; and the total Annual Course Costs are increased 22.5% from $28,982,000 to $35,494,000. These increases can be attributed to changes in manpower requirements for the system which in-turn causes the Annual Student Inputs to increase and not by changes to the training courses. **Section 4** of this report contains a more detailed explanation of the rationale behind the manpower increase. The 121-23R10 course is the high driver of the training resource requirements. The Annual Training Man-Days increased by 91.0% from 30,326 to 57,915; the Annual Instructor Requirements increased 80.6% from 31 to 56; and the Annual Course Costs increased 66.5% from $9,019,000 to $15,017,000. These increases are caused by an Annual Student Inputs increase of 91.4% from 128 to 245. The training resource requirements impacts for the USMC HAWK III system are contained in **Tables 5-8 through 5-10.**

5.6.2 Alternative 2 (PAC-3). The training resource requirements for the PAC-3 system decreased when compared to the Base Case (HAWK III). The total Annual Training Man-Days decreased 46.3% from 102,812 to 55,197; the total Annual Instructor Requirements decreased 46.1% from 115 to 62; and the total Annual Course Costs decreased 56.7% from $28,982,000 to $12,546,000. These decreases are caused by the elimination of the 27J and 27K DS/GS maintenance MOSs, the 25L AN/TSQ-73 maintenance MOS, and the 35Y Integrated Family of Test Equipment MOS. The elimination of these MOSs reduced the training base by seven courses. The training resource requirements impacts for the PAC-3 system are contained in **Tables 5-11 through 5-13.** Section 4 of this report contains an explanation of the MOSs associated with the PAC-3 system. In order to compare the training associated with the PAC-3 and HAWK III systems you must first determine which courses are comparable. The HAWK III 14D and PAC-3 16D MOSs are defined as system operators, therefore, they are comparable. The HAWK III 23R and PAC-3 24T MOSs are defined as unit maintainers (operators and unit maintainers for PAC-3), therefore, they are comparable. The HAWK III 27H, 27J, and 27K and the PAC-3 27X MOSs are defined as the DS/GS maintainers, therefore, they are comparable. Based upon these assumptions the following conclusions can be made:

TABLE 5-8

ANNUAL TRAINING MAN-DAYS
HAWK III VS. USMC HAWK

MOS	COURSE NUMBER	HAWK III	USMC HAWK III	DELTA USMC - HAWK III
23R	121-23R10	30,326	57,915	27,589
27H	121-27H10	7,644	14,112	6,468
27J	104-27J10	3,864	6,762	2,898
23R	121-23R30	897	1,716	819
27H	121-27H30	1,072	1,608	536
63Y	611-63Y10	412	658	246
27J	104-27J30	612	714	102
ADA	0-16-C42 (CMF 16)	1,351	1,528	177
14D	043-14D10	10,640	10,850	210
14D	043-14D30	5,772	5,850	78
25L	150-25L30	117	117	0
35Y	198-35Y10	6,440	6,440	0
63S	610-63S10	412	412	0
27K	104-27K30	980	910	(70)
25L	150-25L10	2,176	1,995	(181)
63B	610-63B30	1,108	767	(341)
63B	610-63B10	2,912	2,160	(752)
52D	662-52D10	2,548	1,315	(1,233)
52C	662-52C10	1,794	560	(1,234)
27K	104-27K10	21,735	18,900	(2,835)
	TOTALS:	102,812	135,289	32,477

TABLE 5-9

ANNUAL INSTRUCTORS
HAWK III VS. USMC HAWK

MOS	COURSE NUMBER	HAWK III	USMC HAWK III	DELTA USMC - HAWK III
23R	121-23R10	31	56	25
27H	121-27H10	11	19	8
27J	104-27J10	5	7	2
23R	121-23R30	1	2	1
27H	121-27H30	1	2	1
ADA	0-16-C42 (CMF 16)	1	1	0
14D	043-14D10	12	12	0
14D	043-14D30	5	5	0
27J	104-27J30	1	1	0
27K	104-27K30	1	1	0
25L	150-25L10	2	2	0
25L	150-25L30	1	1	0
35Y	198-35Y10	10	10	0
63B	610-63B10	1	1	0
63B	610-63B30	1	1	0
63S	610-63S10	1	1	0
63Y	611-63Y10	1	1	0
52C	662-52C10	2	1	(1)
52D	662-52D10	2	1	(1)
27K	104-27K10	25	22	(3)
	TOTALS:	115	147	32

TABLE 5-10

ANNUAL COURSE COSTS
HAWK III VS. USMC HAWK

MOS	COURSE NUMBER	HAWK III	USMC HAWK III	DELTA USMC - HAWK III
23R	121-23R10	9,019	15,017	5,998
27H	121-27H10	3,079	4,045	966
27J	104-27J10	3,106	3,481	375
23R	121-23R30	278	505	227
27J	104-27J30	202	278	76
63Y	611-63Y10	99	158	59
27H	121-27H30	608	654	46
ADA	0-16-C42 (CMF 16)	279	315	36
14D	043-14D10	1,564	1,585	21
14D	043-14D30	1,836	1,853	17
25L	150-25L30	47	47	0
35Y	198-35Y10	1,583	1,583	0
63S	610-63S10	68	68	0
27K	104-27K30	303	281	(22)
25L	150-25L10	450	412	(38)
63B	610-63B30	309	214	(95)
63B	610-63B10	463	343	(120)
52C	662-52C10	415	130	(285)
52D	662-52D10	692	357	(335)
27K	104-27K10	4,582	4,168	(414)
	TOTALS:	**28,982**	**35,494**	**6,512**

TABLE 5-11

ANNUAL TRAINING MAN-DAYS
HAWK III VS. PAC-3

MOS	COURSE NUMBER	HAWK III	PAC-3	DELTA PAC-3 - HAWK III
24T	632-24T10		25,536	25,536
16T	043-16T10		17,017	17,017
16T	043-11-16T30		2,184	2,184
63S	610-63S10	412	1,811	1,399
24T	632-24T30		975	975
27X	121-27X/2/3/4		343	343
ADA	0-16-C42 (CMF 16)	1,351	1,410	59
55D	431-55D10			0
25L	150-25L30	117		(117)
63B	610-63B30	1,108	767	(341)
63Y	611-63Y10	412		(412)
27J	104-27J30	612		(612)
52D	662-52D10	2,548	1,891	(657)
63B	610-63B10	2,912	2,254	(658)
52C	662-52C10	1,794	1,009	(785)
23R	121-23R30	897		(897)
27K	104-27K30	980		(980)
27H	121-27H30	1,072		(1,072)
25L	150-25L10	2,176		(2,176)
27J	104-27J10	3,864		(3,864)
14D	043-14D30	5,772		(5,772)
35Y	198-35Y10	6,440		(6,440)
27H	121-27H10	7,644		(7,644)
14D	043-14D10	10,640		(10,640)
27K	104-27K10	21,735		(21,735)
23R	121-23R10	30,326		(30,326)
	TOTALS:	102,812	55,197	(47,615)

TABLE 5-12

ANNUAL INSTRUCTORS
HAWK III VS. PAC-3

MOS	COURSE NUMBER	HAWK III	PAC-3	DELTA PAC-3 - HAWK III
24T	632-24T10		29	29
16T	043-16T10		21	21
16T	043-11-16T30		2	2
24T	632-24T30		2	2
27X	121-27X/2/3/4		1	1
ADA	0-16-C42 (CMF 16)	1	1	0
63B	610-63B10	1	1	0
63B	610-63B30	1	1	0
63S	610-63S10	1	1	0
52D	662-52D10	2	2	0
27J	104-27J30	1		(1)
27K	104-27K30	1		(1)
23R	121-23R30	1		(1)
27H	121-27H30	1		(1)
25L	150-25L30	1		(1)
63Y	611-63Y10	1		(1)
52C	662-52C10	2	1	(1)
25L	150-25L10	2		(2)
14D	043-14D30	5		(5)
27J	104-27J10	5		(5)
35Y	198-35Y10	10		(10)
27H	121-27H10	11		(11)
14D	043-14D10	12		(12)
27K	104-27K10	25		(25)
23R	121-23R10	31		(31)
	TOTALS:	115	62	(53)

TABLE 5-13

ANNUAL COURSE COSTS
HAWK III VS. PAC-3

MOS	COURSE NUMBER	HAWK III	PAC-3	DELTA PAC-3 - HAWK III
24T	632-24T10		5,699	5,699
16T	043-16T10		3,409	3,409
16T	043-11-16T30		988	988
24T	632-24T30		347	347
63S	610-63S10	68	298	230
27X	121-27X/2/3/4		196	196
ADA	0-16-C42 (CMF 16)	279	291	12
25L	150-25L30	47		(47)
63B	610-63B30	309	214	(95)
63Y	611-63Y10	99		(99)
63B	610-63B10	463	358	(105)
52D	662-52D10	692	513	(179)
52C	662-52C10	415	233	(182)
27J	104-27J30	202		(202)
23R	121-23R30	278		(278)
27K	104-27K30	303		(303)
25L	150-25L10	450		(450)
27H	121-27H30	608		(608)
14D	043-14D10	1,564		(1,564)
35Y	198-35Y10	1,583		(1,583)
14D	043-14D30	1,836		(1,836)
27H	121-27H10	3,079		(3,079)
27J	104-27J10	3,106		(3,106)
27K	104-27K10	4,582		(4,582)
23R	121-23R10	9,019		(9,019)
	TOTALS:	28,982	12,546	(16,436)

(1) **System Operator:** The training resource requirements for the system operator increased when the 16T MOS was compared to the 14D MOS. The Annual Training Man-Days increased 17.3% from 16,412 to 19,255; the Annual Instructor Requirements increased 35.3% from 17 to 23; and the total Annual Course Costs increased 29.3% from $3,400,000 to $4,397,000. The increase was caused by Annual Student Input requirement of 210 for the 043-16T10 course compared to 139 for the 043-14D10 course. This increase off-set the decrease in the Annual Student Input requirement of 54 for the 043-11-16T30 course compared to 148 for the 043-14D30 course. The training resource requirements impacts for the PAC-3 system operator are contained in **Tables 5-14 through 5-16.** The course lengths and ICH had little impact on the instructor and cost differences since they were virtually the same as the compared courses. The course lengths and ICH for the system operator courses are contained in **Table 5-17.**

(2) **Unit Maintainer:** The training resource requirements for the unit maintainer decreased when the 24T MOS was compared to the 23R MOS. The Annual Training Man-Days decreased 15.1% from 31,223 to 26,511; the Annual Instructor Requirements decreased 3.1% from 32 to 31; and the total Annual Course Costs decreased 35.0% from $9,297,000 to $6,046,000. The training resource requirements impacts for the PAC-3 unit maintainer are contained in **Tables 5-14 through 5-16.** The decrease was caused by Annual Student Input requirements of 88 for the 632-24T10 course compared to 128 for the 121-23R10 course. The Annual Student Input for the 632-24T30 course was 24 compared to 23 for the 043-14D30 course. The course lengths and ICH had little impact on the instructor and cost differences since they were virtually the same as the compared courses. The course lengths and ICH are contained in **Table 5-17.**

(3) **DS/GS Maintainer:** The training resource requirements for the DS/GS maintainer decreased when the 27X MOS was compared to the 27H, 27J, and 27K MOSs. The Annual Training Man-Days decreased 99.0% from 35,907 to 343; the Annual Instructor Requirements decreased 97.7% from 44 to 1; and the total Annual Course Costs decreased 98.4% from $11,880,000 to $196,000. The training resource requirements impacts for the PAC-3 unit maintainer are contained in **Tables 5-14 through 5-16.** The

TABLE 5-14

ANNUAL TRAINING MAN-DAYS
HAWK III VS. PAC-3

	HAWK III			PAC-3			DELTA
	MOS	COURSE NUMBER	TRAINING MAN-DAYS	MOS	COURSE NUMBER	TRAINING MAN-DAYS	PAC-3 - HAWK III
OPERATOR	14D	043-14D10	10,640	16T	043-16T10	17,071	
		043-14D30	5,772		043-11-16T30	2,184	
		total	16,412		total	19,255	**2,843**
UNIT MAINTAINER	23R	121-23R10	30,326	24T	632-24T10	25,536	
		121-23R30	897		632-24T30	975	
		total	31,223		total	26,511	**(4,712)**
DS/GS MAINTAINER	27H	121-27H10	7,644	27X	121-27X2/3/4	343	**(35,564)**
		121-27H30	1,072				
	27J	104-27J10	3,864				
		104-27J30	612				
	27K	104-27K10	21,735				
		104-27K30	980				
		total	35,907				

TABLE 5-15

ANNUAL INSTRUCTORS
HAWK III VS. PAC-3

	HAWK III			PAC-3			DELTA
	MOS	COURSE NUMBER	INSTRUCTORS	MOS	COURSE NUMBER	INSTRUCTORS	PAC-3 - HAWK III
OPERATOR	14D	043-14D10	12	16T	043-16T10	21	
		043-14D30	5		043-11-16T30	2	
		total	17		total	23	6
UNIT MAINTAINER	23R	121-23R10	31	24T	632-24T10	29	
		121-23R30	1		632-24T30	2	
		total	32		total	31	(1)
DS/GS MAINTAINER	27H	121-27H10	11	27X	121-27X2/3/4	1	(43)
		121-27H30	1				
	27J	104-27J10	5				
		104-27J30	1				
	27K	104-27K10	25				
		104-27K30	1				
		total	44				

TABLE 5-16

ANNUAL COURSE COSTS
HAWK III VS. PAC-3

	HAWK III			PAC-3			DELTA
	MOS	COURSE NUMBER	COURSE COSTS ($K)	MOS	COURSE NUMBER	COURSE COSTS ($K)	PAC-3 - HAWK III ($K)
OPERATOR	14D	043-14D10	1,836	16T	043-16T10	3,409	
		043-14D30	1,564		043-11-16T30	988	
		total	3,400		total	4,397	**997**
UNIT MAINTAINER	23R	121-23R10	9,019	24T	632-24T10	5,699	
		121-23R30	278		632-24T30	347	
		total	9,297		total	6,046	**(3,251)**
DS/GS MAINTAINER	27H	121-27H10	3,079	27X	121-27X2/3/4	196	**(11,684)**
		121-27H30	608				
	27J	104-27J10	3,106				
		104-27J30	202				
	27K	104-27K10	4,582				
		104-27K30	303				
		total	11,880				

TABLE 5-17

HAWK III AND PAC-3 OPERATOR AND UNIT MAINTAINER COURSE LENGTHS AND INSTRUCTOR CONTACT HOURS

	HAWK III				PAC-3			
	MOS	COURSE NUMBER	COURSE LENGTH (WKS)	ICH	MOS	COURSE NUMBER	COURSE LENGTH (WKS)	ICH
OPERATOR	14D	043-14D10	10	1,317	16T	043-16T10	11	1673
		043-14D30	5.8	557.5		043-11-16T30	5.8	386.5
UNIT MAINTAINER	23R	121-23R10	30	3,605	24T	632-24T10	32	3934
		121-23R30	5.8	555.5		632-24T30	5.8	492.5

decrease was caused by the replacement of three MOSs that provide support to the HAWK III system with one MOS that provides support for the PAC-3 system. The Annual Student Input for the requirements for the 121-27X2/3/4 course is 1 compared to a total of 132 for the HAWK III DS/GS maintainers. A break out of the Annual Student Input requirements by course follows:

- 104-27J10 - 12
- 104-27J30 - 5
- 104-27K10 - 64
- 104-27K30 - 13
- 121-27H10 - 31
- 121-27H30 - 7

5.6.3 Alternative 3 (PAC-3 "Light"). The training resource requirements for the PAC-3 "Light" system are the same as the PAC-3 system. There was no change in the Annual Student Inputs or the course lengths for the PAC-3 "Light" from the PAC-3 system. Therefore, the impacts of the PAC-3 "Light" when compared to the Base Case (HAWK III) are the same as the PAC-3 system.

5.6.4 Alternative 5 (CORPS SAM). The training resource requirements for the CORPS SAM system decreased when compared to the Base Case (HAWK III). The total Annual Training Man-Days decreased 36.5% from 102,812 to 65,236; the total Annual Instructor Requirements decreased 62.6% from 115 to 43; and the total Annual Course Costs decreased 66.8% from $28,982,000 to $9,610,000. These decreases are caused by the elimination of the 23R unit maintenance MOS, 27J and 27K DS/GS maintenance MOSs, the 25L AN/TSQ-73 maintenance MOS, and the 35Y Integrated Family of Test Equipment MOS. The elimination of these MOSs reduced the training base by nine courses. The training resource requirements impacts for the CORPS SAM system are contained in **Tables 5-18 through 5-20**. Section 4 of this report contains an explanation of the MOSs associated with the CORPS SAM system. In order to compare the training associated with the CORPS SAM and HAWK III systems you must first determine which courses are comparable. The HAWK III 14D and CORPS SAM 14X MOSs are defined as system operators, therefore, they are comparable. Since there are no unit, DS, or GS maintainers supporting the CORPS SAM system, there are no comparable training courses in the CORPS SAM training base for the following HAWK III courses:

TABLE 5-18

ANNUAL TRAINING MAN-DAYS
HAWK III VS. CORPS SAM

	HAWK III			CORPS SAM			DELTA
	MOS	COURSE NUMBER	TRAINING MAN-DAYS	MOS	COURSE NUMBER	TRAINING MAN-DAYS	CORPS SAM - HAWK III
OPERATOR	14D	043-14D10	10,640	14X	XXX-14X10	50,675	
		043-14D30	5,772		XXX-14X30	8,385	
		total	16,412		total	59,060	**42,648**
UNIT MAINTAINER	23R	121-23R10	30,326				
		121-23R30	897				
		total	31,223				**(31,223)**
DS/GS MAINTAINER	27H	121-27H10	7,644				
		121-27H30	1,072				
	27J	104-27J10	3,864				
		104-27J30	612				
	27K	104-27K10	21,735				
		104-27K30	980				
		total	35,907				**(35,907)**

TABLE 5-19

ANNUAL INSTRUCTORS
HAWK III VS. CORPS SAM

	HAWK III			CORPS SAM			DELTA
	MOS	COURSE NUMBER	INSTRUCTORS	MOS	COURSE NUMBER	INSTRUCTORS	CORPS SAM - HAWK III
OPERATOR	14D	043-14D10	12	14X	XXX-14X10	31	
		043-14D30	5		XXX-14X30	7	
		total	17		total	38	**21**
UNIT MAINTAINER	23R	121-23R10	31				
		121-23R30	1				
		total	32				**(32)**
DS/GS MAINTAINER	27H	121-27H10	11				
		121-27H30	1				
	27J	104-27J10	5				
		104-27J30	1				
	27K	104-27K10	25				
		104-27K30	1				
		total	44				**(44)**

TABLE 5-20

ANNUAL COURSE COSTS
HAWK III VS. CORPS SAM

	HAWK III			CORPS SAM			DELTA
	MOS	COURSE NUMBER	COURSE COSTS ($K)	MOS	COURSE NUMBER	COURSE COSTS ($K)	CORPS SAM - HAWK III ($K)
OPERATOR	14D	043-14D10	1,836	14X	XXX-14X10	5,841	
		043-14D30	1,564		XXX-14X30	2,446	
		total	3,400		total	8,287	**4,887**
UNIT MAINTAINER	23R	121-23R10	9,019				
		121-23R30	278				
		total	9,297				**(9,297)**
DS/GS MAINTAINER	27H	121-27H10	3,079				
		121-27H30	608				
	27J	104-27J10	3,106				
		104-27J30	202				
	27K	104-27K10	4,582				
		104-27K30	303				
		total	11,880				**(11,880)**

- 121-23R10
- 121-23R30
- 104-27J10
- 104-27J30
- 104-27K10
- 104-27K30
- 121-27H10
- 121-27H30

A small portion of the unit level maintenance tasks will be trained in the XXX-14X10 course. However, this will be limited to computer aided diagnostics and remove and replace actions. The analysis was conducted based upon the following assumptions. The training currently being provided for the HAWK III 14D MOS will be replaced by training provided for the CORPS SAM 14X MOS. There will be no replacement training for the HAWK III 23R, 27H, 27J, and 27K MOSs. The training resource requirements for the system operator increased when the 14X MOS was compared to the 14D MOS. The Annual Training Man-Days increased 260% from 16,412 to 59,060; the Annual Instructor Requirements increased 124.5% from 17 to 38; and the total Annual Course Costs increased 144.0% from $3,400,000 to $8,287,000. However, as stated earlier in this paragraph, the total training resource requirements decreased substantially. This decrease was caused by the elimination of the unit, DS and GS maintenance training requirements. Therefore, a total of 67,130 Annual Training Man-Days, 76 Annual Instructor requirements, and $27,177,000 Annual Course Costs requirements associated with the training courses that support these HAWK III MOSs were eliminated from the CORPS SAM system training resource estimate. These reductions far exceeded the increases associated with the XXX-14X10 and XXX-14X30 courses.

5.7 CORPS SAM OPERATOR TRAINING RISK ASSESSMENT. The two level maintenance concept for the CORPS SAM system as defined in the system's Integrated Logistics Support Plan (ILSP) indicates that the system operator will be the only individual responsible for maintaining the readiness of the system. The system operator will be trained to conduct computer aided diagnostics and to remove and replace BRUs. Repairable BRUs will be sent to depot for repair (70% of the BRUs will be throw-aways). The training provided the CORPS SAM system operator will not include any electronic theory, system or subsystem trouble shooting, or off-line diagnostics. The total training time devoted to

performing computer aided diagnostics and to removing and replacing BRUs is estimated to be 132 hours for the AIT course and eight hours for the BNCOC course. Although, a group of senior system operators will be located in the Headquarters Battery, no other training is envisioned to increase the maintenance skills of these senior system operators. Several questions arise when this maintenance concept is evaluated once it is understood what training will be provided to the system operator.

(1) What happens if the system operator is unable to initialize the CORPS SAM system? How will the operator be able to determine the fault if he is unable to run Test Measurement and Diagnostic Equipment ?

(2) What happens if a diagnostic check indicates that not only is a replaced BRU faulty but that there is a fault in another BRU? Will faulty BRUs be tested prior to disposition? If so, who will test the BRUs?

(3) What happens if the system and/or senior operators are unable to correct the fault? Will the entire subsystem be sent to depot for repair? If so, who will remove and replace the subsystem?

The concept of having a system level operator responsible for the unit level diagnostics and removal and replacement of BRUs for the CORPS SAM system will save both manpower and training resources. However, due to the limited maintenance skills that will be possessed by the system operator and the fact that the next level of maintenance is at depot there is a risk that the unit readiness will suffer.

5.8 SUMMARY. Of the four COEA alternatives studied, Alternative 5 (CORPS SAM) shows a significant decrease in training resource requirements when compared to the Base Case (HAWK III). The decrease is due to the elimination of the unit, DS, and GS maintenance requirements for the CORPS SAM system. This, in turn, causes the system operator training time to increase. The increase operator training time is off-set by the elimination of the need to train unit, DS, and GS maintainers. However, since the system level operator will possess limited maintenance skills and knowledge, it is possible that unit readiness may be degraded.

APPENDIX A

ACRONYM LIST

AMMH	Annual Maintenance Man Hours
AD	Air Defense
ADA	Air Defense Artillery
ADTOC	Air Defense Tactical Operations Center
AEHA	Army Environmental Hygiene Agency
AEPCO	Advanced Engineering and Planning Corp.
ANCOC	Advanced Noncommissioned Officer Course
ANSI	Annual Student Input
AIT	Advanced Individual Training
AOE	Army of Excellence
APM	Assistant Program Manager
ASI	Additional Skill Identifier
ATCCS	Army Tactical Command and Control System
ATE	Automatic Test Equipment
ATRM	Army Training Resource Management
ATTRS	Army Training Requirements and Resources System
BCE	Baseline Cost Estimate
BCS	Baseline Comparison System
BIT/BITE	Built-in Test/Built-in Test Equipment
BM/C^3	Battle Management/Command, Control and Communication
BNCOC	Basic Noncommissioned Officer Course
BOIP	Basis of Issue Plan
BRU	Battery Replaceable Unit
CARD	Cost Analysis Requirements Document
CCB	Configuration Control Board
CE&D	Concept Exploration and Definition
CHS	Common Hardware and Software
CLS	Contractor Logistic Support
COEA	Cost and Operational Effectiveness Analysis
CORPS SAM	CORPS Surface-to-Air Missile

CTEA	Cost and Training Effectiveness Analysis
C^3I	Command, Control, Communications, and Intelligence
CWAR	Continuous Wave Acquisition Radar
DA	Department of the Army
DAB	Defense Acquisition Board
DCD	Directorate of Combat Developments
DEM/VAL	Demonstration and Validation
DoD	Department of Defense
DOTD	Directorate of Training and Development
DRC	Dynamics Research Corporation
DS	Direct Support
ECA	Early Comparative Analyses
ECC	Electronic Countermeasures
ECCM	Electronic Counter Countermeasures
EEA	Essential Elements of Analysis
EMD	Engineering and Manufacturing Development
EOD	Explosive Ordnance Disposal
EODT	Explosive Ordnance Disposal Trainer
ERINT	Extended Range Interceptor
FBHN	Fort Benjamin Harrison
GBS	Ground Based Sensor
GFE	Government Furnished Equipment
GFI	Government Furnished Information
GMT	Guided Missile Transporter
GPALS	Global Protection Against Limited Strikes
GS	General Support
HARDMAN	Hardware versus Manpower
HATMD	High Altitude Theater Missile Defense
HAWK	Homing All the Way Killer
HFE	Human Factors Engineering
HFEA	Human Factors Engineering Assessment
HHA	Health Hazard Assessment
HMI	Human-Machine Interface
HPI	High Powered Illuminating

HSI	Human Systems Integration
ICC	Integrated Command Center
IDS	Intermediate Direct Support
ILS	Integrated Logistic Support
ILSP	Integrated Logistic Support Plan
JMSNS	Justification for Major System New Start
LRU	Line Replaceable Unit
LSA	Logistics Support Analysis
LSAR	Logistics Support Analysis Record
MANPADS	Man-Portable Air Defense System
MANPRINT	Manpower and Personnel Integration
MARC	Manpower Requirements Criteria
MATDEV	Materiel Developer
MER	Manpower Estimate Report
MOPP	Mission Oriented Protective Posture
MOS	Military Occupational Specialty
MPT	Manpower, Personnel, and Training
M/R	Maintenance Ratio
MRD	Manpower Requirements Determination
MTOE	Modified Table of Organization and Equipment
NBC	Nuclear, Biological, and Chemical
NETP	New Equipment Training Plan
OMS	Operator, Maintainer, Support
OMS/MP	Operational Mode Summary/Mission Profile
O&M	Operator and Maintainer
O&O	Operational and Organizational
ORD	Operational Requirements Document
O&M	Operation and Support
OWL	Operator Workload
PAC	PATRIOT Advanced Capabilities
PATRIOT	Phased Array Tracking Radar To Intercept Of Target

PCP	Platoon Command Post
PM	Program Manager
PMO	Program Management Office
POI	Program of Instruction
QQPRI	Qualitative and Quantitative Personnel Requirements Information
RAM	Reliability, Availability, and Maintainability
RF	Radar Frequency
RFP	Request for Proposal
RRR	RAM Rationale Report
SAC	Study and Analysis Center
SAM	Surface-To-Air Missile
SDC	Sample Data Collection
SME	Subject Matter Expert
SMMP	System MANPRINT Management Plan
SRC	Standard Requirements Code
SSI	Special Skill Identifier
SSMP	System Safety Management Plan
SSPP	System Safety Program Plan
SSWG	System Safety Working Group
STP	Soldier Training Publication
STRAP	System Training Plan
TA	Task Analysis
TAD	Target Audience Description
TADDS	Training Aids, Devices, Simulators and Simulations
TBM	Tactical Ballistic Missile
TDA	Table of Distribution and Allowances
THAAD	Theater High Altitude Area Defense
TIWG	Test Integration Working Group
TMD	Theater Missile Defense
TOC	Tactical Operations Center
TOE	Table of Organization and Equipment

TRAC	TRADOC Analysis Command
TRADOC	Training and Doctrine Command
TRRA	Training Resource Requirements Analysis
TSG	The Surgeon General's Office
TSM	TRADOC System Manager
USAADASCH	United States Army Air Defense Artillery School
USAOCS	United States Army Ordnance Center and School
USAMICOM	United States Army Missile Command
USAOMMCS	United States Army Ordnance, Missile, and Munitions Center and School
USASSDC	United States Army Space and Strategic Defense Command
URS	Unit Reference Sheet
WSMR	White Sands Missile Range

APPENDIX B

LIST OF DOCUMENTS

The following documents, reports, and training publications have been reviewed and, in some cases, used as references as part of the CORPS SAM MPT analysis:

- CORPS SAM System Operational Description, 14 August 1991, U.S. Army Air Defense Artillery School (USAADASCH), Fort Bliss, Texas (SECRET).
- Operational Requirements Document (ORD) Initial Draft for CORPS SAM System, 24 July 1992, USAADASCH, Directorate of Combat Developments (DCD), Fort Bliss, Texas.
- CORPS SAM System MANPRINT Management Plan (SMMP), August 1992, USAADASCH-DCD, Fort Bliss, Texas.
- CORPS SAM System Training Plan (STRAP), 6 June 1992, USAADASCH, Directorate of Training Development (DOTD), Fort Bliss, Texas.
- CORPS SAM Integrated Logistics Support Plan, April 1992, Global Protection Against Limited Strikes (GPALS) Program Executive Office (PEO), CORPS SAM Program Management Office, Huntsville, Alabama.
- PATRIOT Air Defense System HARDMAN study, June 1987, Dynamics Research Corp.
- I-HAWK HARDMAN study, December 1986, Dynamics Research Corp.
- Non-Line-of-Sight (NLOS) Air Defense/Anti-Tank (AD/AT) HARDMAN study, February 1990, Hay Systems Inc.
- Medium-Surface-to-Air Missile (MSAM) HARDMAN study, February 1989, Hay Systems Inc.
- High-to-Medium-Altitude Air Defense Command, Control, Communications, and Intelligence (HIMAD C^3I) Early Comparative Analysis study, October 1991, Hay Systems Inc.

- CORPS SAM Cost and Operational Effectiveness Analysis (COEA) Study Plan, August 1992, TRADOC Analysis Command, Study and Analysis Center, Fort Leavenworth, Kansas.

- MANPRINT 2000: Program Assessment and Enhancement, 15 May 1992, Deputy Under Secretary of the Army for Operations Research.

- Training Programs of Instruction (POIs), including instructor contact hour (ICH) worksheets, from the USAADASCH-DOTD for the following courses of instruction:

  -- 14D 2-44-C20, HAWK Weapon System Qualification (Phase III/Phase II) Air Defense Artillery Officer Basic (Draft), April 1992.

  -- 4F-140D (PIP III), HAWK Missile System Technician Warrant Officer Technical/Tactical Certification, July 1990.

  -- 043-14D10, HAWK Missile Crew Member, December 1991.

  -- 043-14D30, HAWK Missile System Crew Member (BNCOC), January 1992.

  -- 121-23R10, HAWK Missile System Mechanic, April 1990.

  -- 121-23R30, HAWK Missile System Mechanic (BNCOC), January 1992.

  -- 121-25L10, AN/TSQ-73, Air Defense Artillery Command and Control System Operator/Repairer, July 1990.

  -- 150-25L30, AN/TSQ-73, Air Defense Artillery Command and Control System Operator/Maintainer (BNCOC), January 1992.

  -- 4F-140E, PATRIOT System Technician Warrant Officer Technical/Tactical Certification, July 1991.

  -- 043-16T10, PATRIOT Missile Crew Member, November 990.

  -- 043-11-16T30, PATRIOT Missile Crew Member (BNCOC), January 1992.

  -- 632-24T10, PATRIOT Operator and System Mechanic, February 1991.

-- 632-24T30, PATRIOT Operator and System Mechanic (BNCOC), January 1992.

- System Training Publications (STPs) from the USAADASCH-DOTD for the following MOSs:

  -- STP 44-14D14-SM-TG, HAWK Missile System Crew Member, July 1991.

  -- STP 44-14D14-SM-TG C-1, HAWK Missile System Crew Member, July 1991.

  -- STP 44-23R15-SM-TG, HAWK Missile System Mechanic, September 1991.

  -- STP 44-23R15-SM-TG C-1, HAWK Missile System Mechanic, September 1991.

  -- STP 44-25L14-SM-TG, AN/TSQ-73 Air Defense Artillery (ADA) Command and Control System Operator/Maintainer, October 1991.

  -- STP 44-24T1-SM, PATRIOT Operator and System Mechanic, March 1990.

  -- STP 44-24T1-SM C-1, PATRIOT Operator and System Mechanic, January 1992.

  -- STP 44-24T25-SM-TG, PATRIOT Operator and System Mechanic, March 1990.

  -- STP 44-24T25-SM-TG C-1, PATRIOT Operator and System Mechanic, January 1992.

  -- STP 44-16T1-SM, PATRIOT Missile Crew Member, February 1990.

  -- STP 44-16T1-SM C1, PATRIOT Missile Crew Member, January 1992.

  -- STP 44-16T24-SM-TG, PATRIOT Missile Crew Member, February 1990.

  -- STP 44-16T24-SM-TG C1, PATRIOT Missile Crew Member, January 1992.

- STRAP for HAWK Mobility Enhancement (HME) Material Change (MC), USAOMMCS-DOTD, May 1992.

- STRAP for PATRIOT Air Defense Artillery Missile System, USAADASCH-DOTD, January 1992.

- Training POIs from the USAOMMCS-DOTD for the following courses of instruction:

  -- 121-27H10, HAWK Firing Section Repairer.

  -- 121-27H30, HAWK Firing Section Repairer (BNCOC).

  -- 104-24J10, HAWK Field Maintenance Equipment/Pulse Acquisition Radar Repairer.

  -- 104-24J30, HAWK Field Maintenance Equipment/Pulse Acquisition Radar Repairer (BNCOC).

  -- 104-27K10, HAWK Continuous Wave (CW) Radar Repairer.

  -- 104-27K30, BNCOC, HAWK Continuous Wave (CW) Radar Repairer.

  -- 121-27X 2/3/4 PATRIOT System Repairer (Phase 1 and2).

  -- 1-27-C42A, Land Combat ANCOC.

  -- 1-27-C42C, HAWK ANCOC.

  -- 198-35Y10 Integrated Family of Test Equipment Operator/Maintainer, June 1992.

  -- 4E-91E/431-55D10/20 Phase III, EOD Specialist, May 1992.

- STPs from the USAOMMCS-DOTD for the previously listed MOSs plus:

  -- STP 9-55D14-SM-TG, EOD Specialist, Skill Levels 1-4, April 1989.

- Training POIs, including ICH worksheets, from the USAOCS-DOTD for the following courses of instruction:

-- 662-52C10, Phase I, Utilities Equipment Repairer (BNCOC).

-- 662-52D10, Power Generation Equipment Repairer.

-- 662-52D30, Phase II, Senior Power Generation Equipment Repairer (BNCOC) Technical Track.

-- 610-63B10, Light Wheel Vehicle Mechanic.

-- 610-63B30, Light Wheel Vehicle Mechanic (BNCOC).

-- 610-63S10, Heavy Wheel Vehicle Mechanic.

- STPs from the USAOCS-DOTD for the above listed MOSs.